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JOURNAL  
OF  
(THE) FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY  
OF  
MECHANICAL AND PHYSICAL SCIENCE,  
CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,  
AND OF  
AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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*VOL. 40*  
THIRD SERIES.

VOL. X.

PHILADELPHIA.

PUBLISHED BY THE FRANKLIN INSTITUTE, AT THEIR HALL.

1845

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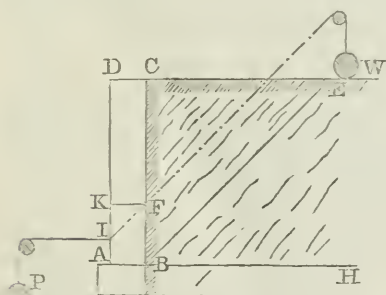
CIVIL ENGINEERING.

*Remarks on Barlow's Investigation of "the Pressure of Banks and Dimensions of Revetments."* By D. P. WOODBURY, Lt. U. S. Engineers.

Barlow's "Treatise on the strength of timber, cast iron, and other materials," is a work of great merit, embodying a vast amount of information of the utmost importance to all engineers and builders.

It is a work too, we believe, extensively used both in England and in this country; and this fact, we trust, will justify the purpose of this paper, that of pointing out some errors in that author's investigation of "the pressure of banks and the dimensions of revetments."

From the fourth edition (London, 1837,) page 196 and subsequent, we make the following extract:



"Let CBHE (in the annexed figure) denote a bank of earth, the natural slope of which is EB.— Let the weight of the part CBE, one foot thick =  $W$ , and make  $BE = l$ ,  $CB = h$ ,  $CE = b$ . From the theory of the inclined plane,

$$\text{as } l : h :: W : \frac{h}{l}W = W',$$

the weight which, attached to the centre of gravity of the sliding solid, would preserve it in equilibrio on the plane  $EB$ , supposing no friction between the two surfaces. The weight  $W'$  will, therefore, under this supposition, denote the quantity,  $FI$  the direction, and  $I$  the effective point of application of the force of the bank against the wall  $ABCD$ . And now, to find the horizontal force at  $I$ : since the triangles  $KFI$  and  $BEC$  are similar, we have by the resolution of forces

$$l : b :: W' : \frac{b W'}{l} = \frac{b h W}{l^2},$$

for the horizontal effect at  $I$ : also, since  $KA$ , from the nature of the centre of gravity  $= \frac{1}{3}$  of  $DA$ , or  $\frac{1}{3}h$ ;

$$\text{and } KI = \frac{hx}{b}, \text{ and } AI = \frac{1}{3}h - \frac{hx}{b},$$

( $x$  being taken to denote the breadth of the wall at bottom,) the whole effect of the above pressure to turn the wall as a lever about a fulcrum at  $A$ , will be expressed by

$$\left( \frac{1}{3}h - \frac{hx}{b} \right) \frac{b h W}{l^2}, \text{ or } \left( \frac{1}{3}h - \frac{hx}{b} \right) \frac{b^2 h^2 S}{2 l^2},$$

$S$  denoting the specific gravity of the earth.

"Now, to find the dimensions of the revetment requisite to keep this force in equilibrio, let  $h'$  denote the given height of the wall;  $S$  its specific gravity, or the weight of one cubic foot;  $x$ , as above, the thickness of the wall at the bottom;  $y$  the distance of the perpendicular, let fall from its centre of gravity upon its base, from the outward edge of the wall at bottom, viz. the point about which the wall turns; and  $a$  the area of its transverse vertical section; then, since we are only considering one foot in length, the same quantity,  $a$ , will also denote the solid content of the wall opposed to the bank; and, consequently,  $a S$  will be its weight."

"Therefore, by the preceding proposition

$$F = y a S,$$

the resistance which the wall opposes in consequence of its weight, and

$$F' = C x^2,$$

the resistance from cohesion,  $C$  being a constant quantity,  $\frac{1}{16}$  of which we may take  $= 500$  as in the preceding article; whence

$$y a S + C x^2$$

will be the whole resistance opposed to the bank; and, consequently, in case of an equilibrium, or of an equality between the force of pressure of the bank and the resistance of the wall, we shall have

$$y a S + C x^2 = \frac{b^2 h^3 S}{6 l^2} - \frac{b^2 h^3 S x}{2 b l^2};$$

a general formula, from which  $x$ , the breadth of the wall, in all cases may be determined."

This investigation begins with the supposition that the prism of

earth, of which B C E is the transverse section, tends, under the action of its own weight, to descend along the natural slope B E, without any resistance from friction. Now the moment we discard the effect of friction, in other words suppose it zero, we endow the embankment with the characteristic of a fluid: so that its pressure against the back of the wall should be the same for all directions of the line B E, and equal to that of a fluid of the same specific gravity.

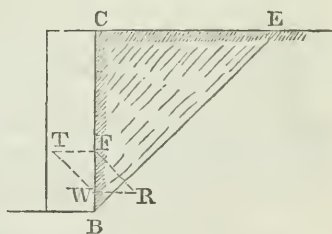
We might assume this as known *à priori*, but we arrive at the same conclusion by a direct examination of the forces.

We may regard the prism B C E as a wedge, impelled by its own weight, against the planes B E, B C, and determine, on the principles of the wedge, the pressure on the surface B C; or we may regard that prism as a weight tending to slide down the inclined plane B E, and determine, by the theory of the inclined plane, the horizontal force, or reaction of the wall, necessary to prevent the descent.

In either view the forces acting are :

- (1.) The weight of the prism =  $W$ , in a vertical line;
- (2.) The pressure upon the inclined plane =  $R$ , perpendicular to B E;
- (3.) The pressure upon the back of the wall or *the thrust* =  $T$ , perpendicular to B C.

The first is kept in equilibrio by the reaction of the other two. The three, regarded as emanating from F (B F =  $\frac{1}{3}$  B C,) are represented, in magnitude and direction, by the sides of the triangle T W F, similar to the triangle B C E since the sides of the first are respectively perpendicular to those of the last. In the triangle T F W we have F W =  $W$ ; T W = F R =  $R$ ; and F T =  $T$ . And we have, by similarity of figures



$$C E : W :: B C : T = \frac{B C}{C E} W = \frac{h}{b} W = \frac{1}{2} s h^2,$$

since  $W = \frac{1}{2} s h b$ . This expression for *the thrust* is independent of the direction B E, or of the natural slope, and exactly equal to the pressure, on a vertical surface of the height of  $h$ , caused by a fluid whose density is represented by  $s$ .

The particular error of Mr. Barlow consists in partially neglecting the reaction of the inclined plane. He resolves  $W$  into two components, the first horizontal, the second vertical; whereas the second should have been perpendicular to B E, so as to be neutralized by the inclined plane. There is nothing to neutralize the discarded vertical component, which is, in fact, so much remaining weight, whose agency in the thrust is still to be determined, whose value is  $W' \frac{h}{l}$ , whose pressure on B C is

$$W' \frac{h}{l} \times \frac{h}{b} = \frac{h^2}{l^2} \times \frac{W h}{b} = \frac{1}{2} s h^2 \times \frac{h^2}{l^2};$$

and this is the exact measure of the error. Adding this to the expression for the thrust given in the foregoing extract, we have

$$\frac{1}{2} s h^2 \frac{b^2}{l^2} + \frac{1}{2} s h^2 \frac{h^2}{l^2} = \frac{1}{2} s h^2 = T;$$

as already obtained. The error we remark is more than half the thrust so long as the natural slope is steeper than  $45^\circ$ .

By a singular coincidence this error, tending to correct the hypothesis of no friction, renders the relation

$$T' = \frac{b h W}{l^2} = \frac{1}{2} s h^2 \frac{b^2}{l^2} = \frac{1}{2} s h^2 \sin.^2 \alpha;$$

(in which  $\alpha$  represents the angle between the natural slope and a vertical) a pretty good practical formula for *the thrust*, as will soon appear.

When friction is taken into view, the horizontal force necessary to prevent the descent of any weight  $W$  down a plane whose inclination to the vertical is represented by  $v$ , is given by the formula

$$F = W \left( \frac{\cos. v - f \sin. v}{\sin. v + f \cos. v} \right)$$

(See bottom of page 5, Journal Fr. Ins. Jan. No. 1843; or any work on mechanics which gives that force,) in which  $f$  is the ratio of friction to normal pressure. In the case of earth,  $a$  still representing the complement of the natural slope, we have  $f = \cot. a$ . Hence, dividing throughout by  $\sin. v$

$$F = W \frac{\cot. v - \cot. a}{1 + \cot. v \cot. a} = W \tan. (a - v) = \frac{1}{2} s h^2 \tan. (a - v) \tan. v.$$

To obtain the greatest possible value of this expression it is only necessary to divide the angle  $a$  into two such parts that the tangent of one multiplied by that of the other shall give the greatest product. Let  $d$  be the half difference between the two angles. Then

$$\begin{aligned} \tan. (a - v) \tan. v &= \tan. \left( \frac{1}{2} a + d \right) \tan. \left( \frac{1}{2} a - d \right) \\ &= \frac{\tan. \frac{1}{2} a + \tan. d}{1 - \tan. \frac{1}{2} a \tan. d} \times \frac{\tan. \frac{1}{2} a - \tan. d}{1 + \tan. \frac{1}{2} a \tan. d} = \frac{\tan.^2 \frac{1}{2} a - \tan.^2 d}{1 - \tan.^2 \frac{1}{2} a \tan.^2 d} = \\ &= \tan.^2 \frac{1}{2} a + \left( \frac{\tan.^2 \frac{1}{2} a - \tan.^2 d}{1 - \tan.^2 \frac{1}{2} a \tan.^2 d} - \tan.^2 \frac{1}{2} a \right) = \\ &= \tan.^2 \frac{1}{2} a - \tan.^2 d \left( \frac{1 - \tan.^4 \frac{1}{2} a}{1 - \tan.^2 \frac{1}{2} a \tan.^2 d} \right) \end{aligned}$$

The fractional factor of the last term is always positive; it is therefore clear that the greatest value results from  $d = 0$ ; hence

$$F = T = \frac{1}{2} s h^2 \tan.^2 \frac{1}{2} a;$$

a result given in many works; see particularly Poncelet on Revetments, a translation by Capt. Sanders of a part of which is published in this Journal, commencing in the January No. for 1843, already cited.

It supposes the earth to be without cohesion or adhesion and without friction upon the back of the wall, but takes into view the friction of earth upon the slope of descent; and on these suppositions there is no doubt of its accuracy. Now let us compare this theoretic thrust with Mr. Barlow's practical thrust, or

$$T = \frac{1}{2} s h^2 \tan.^2 \frac{1}{2} a, \text{ with } T' = \frac{1}{2} s h^2 \sin.^2 a,$$

We see that the last is always the greatest. The ratio of the practical to the exact is the coefficient of stability. This ratio or coefficient is

$$k = \frac{T'}{T} = \frac{\sin.^2 a}{\tan.^2 \frac{1}{2} a};$$

For very small values of  $a$  we have, sensibly,  $\sin. a = 2 \tan. \frac{1}{2} a$ , or  $k = 4$ ; and when  $a$  is nearly  $90^\circ$ , we have, sensibly,  $\sin. a = \tan. \frac{1}{2} a$ , or  $k = 1$ .

We give a few intermediate values:

$a = 35^\circ$	$k = 3.31$	$a = 55^\circ$	$k = 2.48$
$a = 40^\circ$	$k = 3.12$	$a = 60^\circ$	$k = 2.25$
$a = 45^\circ$	$k = 2.91$	$a = 65^\circ 32'$	$k = 2.$
$a = 50^\circ$	$k = 2.70$		

We see that Mr. Barlow's coefficient of stability is too small for very fluid earths, that it is too great for very stiff earths, that for common earths whose natural slope is about  $35^\circ$  ( $a = 55^\circ$ ) this coefficient being nearly 2.50 is about right since the cohesion of masonry is also taken into view, and that the formula is abundantly safe as a practical guide.

But in the application of this formula to the determination of the thickness of sustaining walls, another error is committed which we shall now proceed to notice—an error more serious since its tendency is to diminish the thickness of the wall.

Simple inspection of the general formula.

$$y a S + C x^2 = \frac{b^2 h^3 s}{6 l^2} - \frac{h^2 h^3 s x}{2 b l^2} \quad \text{or}$$

$$y a S + C x^2 = \frac{b^2 h^2 s}{2 l^2} \left( \frac{1}{3} h - \frac{h x}{b} \right)$$

shows that the embankment will sustain itself without any aid from the wall, wherever we have

$$\frac{1}{3} h - \frac{h x}{b} = 0; \text{ or } x = \frac{1}{3} b = \frac{1}{3} h \tan. a;$$

for this thickness reduces the moment of the thrust to zero, whatever be the density of the embankment. For example, the natural slope being  $45^\circ$ , the thickness can never exceed one-third the height, though the wall be as light as a feather, and  $C$ , the cohesion of masonry, zero.

This error arises from taking  $A I$ , and not  $A K$  as the lever arm of pressure. The point of application of the thrust is at  $F$ , ( $B F = \frac{1}{3} B C = \frac{1}{3} h$ ), as virtually admitted by the author; its direction is  $F K$  horizontal; and its moment, in relation to any point, is, according to

the principles of mechanics, the force multiplied by the perpendicular distance of the point from its line of direction. Were  $FI$  the direction of any force, its lever arm would be a perpendicular from  $A$  to the line  $FI$  prolonged if necessary.

On this subject, the author remarks:—"We may further observe, that the method of resolving the force of the bank at the point  $I$ , instead of the point  $F$ , which former is obviously the effective point as regards the lever by which the wall turns, shows, that while the continuation of the slope falls within the base of the wall, the soil which forms it will add to the stability of the revetment; which is conformable to the experiments of Col. Pasley."—[See vol. iii of that author's "Course of Military Instruction."]

We have not access to the work of Col. Pasley, but will suggest another explanation of the fact alluded to.

The force of friction and adhesion upon the back of the wall, is always a force of some, and it may be, of great magnitude. Acting in a vertical line down the wall, its lever arm is the whole thickness of the base, and its moment, tending to prevent rotation, increases in the direct ratio of that thickness. Moreover, if this force be as great, in proportion to the normal pressure or thrust, as the friction of the earth moving upon itself, it will, when combined with the thrust, give a resultant parallel to the natural slope; and this resultant, whatever be its direction, may be taken, both in magnitude and direction, as the effective action of the embankment upon the wall; and if it fall within the base, the embankment will, of course, strengthen the revetment. But when this force is itself zero, as supposed in Mr. Barlow's analysis, the resultant just mentioned is the thrust itself—a horizontal force, which cannot fall within the base, or have its elevation affected by the thickness of the wall.

In practical formulas for revetment walls, it has not been customary to suppose any adhesion or friction upon the back of the wall; for although these forces may act during a set of experiments, and for a limited time in practice, it is not certain that they would always act, but, on the contrary, they might fail at the very time when most needed. Revetments intended to endure for ages must be regarded as exposed to earthquakes and other powerful disturbing causes. During long continued dry weather, cracks may be formed running down the wall and in other places, which, being suddenly filled with rain water, may not only destroy most of the adhesion, but give to the embankment something of the character of a fluid. If one of these cracks extending from the foot of the wall in any direction to the surface, were suddenly filled with water, so as to allow a prism of earth to descend unresisted by friction, that prism, though it might not weigh five pounds, would exert upon the wall all the pressure due to a fluid of the same height and density. It is not pretended that such cracks can ever be perfectly formed, or the friction entirely destroyed, but something like this may evidently take place.

Mr. Barlow states the importance of experiments on a large scale to determine the absolute thrusts of different earths, the cohesion of common masonry, &c.

Something valuable has been furnished and may still be furnished by the falling down of old walls: for when they fall after standing many years, we have, generally, a right to suppose they were almost strong enough, and from their profiles we can easily calculate the force which overturned them, and which they should have been able to withstand.

Ten well-reported cases of this kind would be worth more, probably, than any set of experiments, however elaborate or skilfully conducted.

Such reports should make known, fully :

(1.) The nature of the embankment, the weight of a cubic foot, and the natural slope of earth, as well as can be ascertained.

(2.) The character of the wall, the weight of a cubic foot, and the pulling force necessary to separate a square foot of surface—the force acting at right angles to the joint of separation.

(3.) The nature of the foundation, whether mud, sand, clay, gravel, &c., and whether compressible or incompressible.

(4.) The exact profile of the wall, embankment, and artificial foundations, as first constructed; and, if the rotation was gradual, the change in the direction of the faces prior to the fall.

(5.) The extent of the wall overthrown: and all other particulars calculated to throw light upon the case.

The formula for the thickness of vertical revetments, if the principles advanced in this paper are correct, should stand thus :

$$x = h \operatorname{tang.} \frac{1}{2} a \sqrt{\frac{k s h}{3(S h' + 2 C)}}, \text{ or}$$

$$x = \frac{b h}{l + h} \sqrt{\frac{k s h}{3(S h' + 2 C)}};$$

in which  $k$  is the coefficient of stability, and  $C$  about one-tenth the pulling force necessary to separate a square unit of surface—otherwise more accurately determined by the means described in Mr. Barlow's work.

Making  $h = 12$  feet;  $h' = 12$  feet;  $a = 45^\circ$ ;  $S = 156$  lbs.;  $s = 125$  lbs.; and  $C = 500$  lbs.; that author obtains,  $x = 2'.435$ ; which our formula also gives when we suppose  $k = 1.38$ .

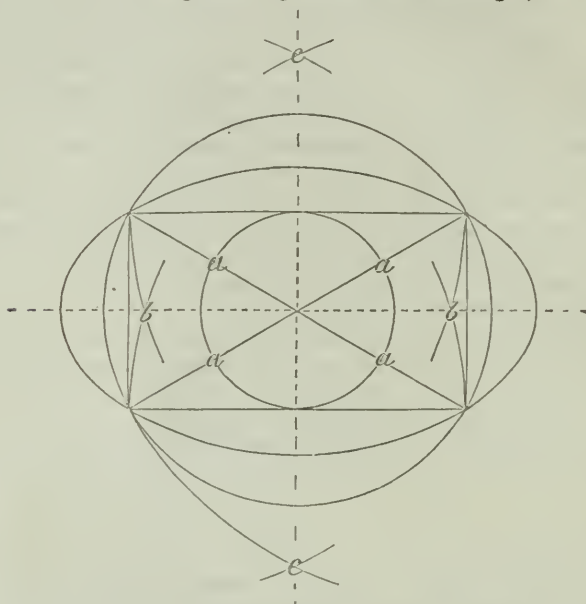
For  $k = 2$ , a common value, we have  $x = 2'.933$ .

It is, doubtless, proper in many cases to take the cohesion of masonry into view. It would not, however, be proper to graduate, in view of any such aid, walls of fortifications liable to be battered by cannon; or walls of any structure exposed to unequal settling and consequent cracks.

In conclusion, it is necessary to remark, in justice to Mr. Barlow, that he himself has pronounced the investigation in question "a very imperfect sketch," and that it has evidently received much less of his attention than many other matters treated of in his book.

*A new Method to Project Circles Isometrically.* By THOMAS PROSSER, C. E., New York.

Fig. 1. Draw the two Isometrical diameters; (*i.e.* the two equi-conjugate diameters of the ellipse which is to represent the circle,) unite their vertices so as to form a rectangle with its diagonals; circumscribe the whole with a circle passing through each angle of the parallelogram, the sides of which will thus form chords to its segments; with the chord of half the arc of a lesser segment as radius, describe another concentric circle cutting the diagonals of the rectangle, at *a, a, a, a*.



From each angle of the rectangle as centres, and with its largest side as radius, describe arcs cutting each other within the rectangle as at *b, b*. From the same centres, and with the diagonal of the rectangle as radius, describe arcs on the opposite side of the figure, as at *c, c*.

From each of the points *a, a, a, a*, as centres, describe arcs passing through the vertices of the isometrical diameters which are on the same side of the conjugate axis, but on the opposite side of the transverse one. From the points *b, b*, and *c, c*, as centres, describe arcs in continuation.

*Note.*—*b, b* are on the transverse axis of the ellipse, and *c, c*, on a line in continuation of the conjugate axis on either side of it.

*On the Comparative Advantages of Atmospheric Railways.*

The paper by Mr. P. W. Barlow, on the Comparative Advantages of the Atmospheric system of Propulsion on Railways, was the result

of an examination of the system, with a view to determine as to the propriety of adopting it on the Tunbridge Wells Branch of the South Eastern Railway. The author first examined the comparative advantages of the atmospheric system over that of traction by a rope; and then he stated the reasons for supposing it to be inferior to the locomotive system. He premised that on lines similar to the Greenwich and Blackwall, where the traffic was nearly uniform, and at short intervals, the power used admitted of mathematical computation; but that on railways generally, the power required must be irregular, both as the amount required and the duration of its employment, and that therefore a power which was restricted to carrying between certain given points only, and certain intervals, would lead to great inconvenience in practice. It would be inconvenient also to have a power which could not be employed for the ordinary repairs of the road, ballasting, removing slips, conveying building materials, working the coal and lime traffic at sidings, moving goods, trucks, carriages, &c. at the stations, all which was done at present by the locomotives with a great saving of time, and of the expense of men and horses. If locomotives were employed for these purposes only, it must be at a great expense; as the keeping up a small locomotive establishment was very costly, and moreover the gradients and curves of the line must be adapted for working locomotives, and thus do away with one of the great arguments in favor of the atmospheric system. It was contended that the subsidence of embankments which at present constantly occurs without interrupting the usual traffic or being perceived by the passengers, would suffice to rupture the air-pipe or strain it in such a manner that the valve would not close, and thus cause a stoppage of the line. Many other and similar practical objections were stated against the system; but the main point was in the comparative cost of haulage, when examined with stationary and with the locomotive engines. With the former it was contended, that on lines with unfrequent trains, the small portion of time the power was actually employed, and the number of hours for which the steam must be kept up in order to be always ready, would be so disproportionate as to make the stationary engine system far more expensive than locomotive power. The lines with steep gradients were of course excluded from this position. It was considered also that with the atmospheric system, steep gradients increased the expense of power in the same ratio, as the power must always be exerted in whatever way it was applied. Several experiments were then given to show the great expense of fuel per ton of goods on the atmospheric railway, the results were decidedly in favor of the locomotive. The cost of construction was then examined, and it appeared, that referring to the calculation of the cost of working the London and Birmingham line, to lay down the atmospheric apparatus of a double line with a pipe of the required area, would not be less than 10,000*l.* per mile, or a total cost of 1,120,000*l.*, the interest of which sum at 5 per cent. would be 56,000*l.*, or 500*l.* per mile, which sum nearly equalled the average cost of working the line by locomotives, and was greater than on many lines. In fact, that a contract might be entered into for

working a line by locomotive power, for the interest of the sum which would be expended in the establishment of an atmospheric apparatus. —The general results deduced were in accordance with these observations, and it was assumed that the atmospheric system could be most advantageously adopted on short lines, with frequent traffic near large towns, where the absence of noise was important; and that railways on steep inclines in one direction, as at Dalkey, was most favorable to the system. In the discussion which ensued, it was contended that many of the objections urged by Mr. Barlow were not well founded, and that many of the practical difficulties he had advanced, had been overcome by the mechanical arrangements now in progress of execution on the more extensive lines, which were destined to be worked on the atmospheric system. That both sidings and level crossings were practicable; by a very simple contrivance, a self-acting platform could be so arranged as not only to guarantee the pipe from any injury by the traversing of a cart across the line, but that by the action of the vacuum in the main, a barrier could be raised on the passing of a train which would effectually prevent the traversing of any vehicle, and thus avoid the possibility of accidents. —That instead of the assumed liability to be thrown off the rails, it was shown that the leading carriage being tied down to the piston, greater security was attained, and that on one occasion the leading carriage on the Dalkey line had started before its time, and had actually traversed the distance at a speed of nearly 70 miles per hour, going round curves 130 to 180 yards radius. That the power stated to have been expended in the conveyance of a given gross load, was assumed at too high a ratio, and the fuel also; and that as to the question of cost by haulage by the adoption of small steam power worked only for pumping water, to be used only at the time of forming the vacuum for unfrequent or for light trains, a system of propulsion might be established, which would be more economical than that by locomotives under the best management.

Trans. Soc. Arts.—Athenæum.

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### *Vulcanized India Rubber.*

At a meeting of the Institution of Civil Engineers, February 4, 1845, Mr. Brockedon exhibited some specimens of his "Vulcanized" India Rubber for diminishing the vibration of railways, by a layer of the material being introduced instead of the patent felt, between the base of the chair and the surface of the sleeper. The preparation was a mixture of caoutchouc and sulphur. Its elasticity was of a surprising character, and was stated to be preserved under intense pressure for a long period. It had been tried on the Great Western with success.

London Athenæum.

## AMERICAN PATENTS.

*List of American Patents which issued in the month of November, 1844, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For an improvement in the apparatus for the *Treatment of Fractures of Limbs*; Livingston Roe, White plains, Westchester county, New York, November 6.

The improvement in question is applied to the well known frame which is provided with joints and extension bars and screws to adapt it to limbs of various sizes, and to extend and retain the limb in any desired position, and consists of "three troughs or movable splints made of wood and so shaped as to correspond with the half of the leg and heel. The three differ in size only, and may be adapted to legs of all sizes. On the lower or convex side of these troughs or splints, and at about equal distance from the extremities thereof, is fastened a plate of metal with flanches on each side of it, and at such distance from each other as to fit the bar when the splints are placed upon it. And the design of them is to secure the said movable splints when sliding on the bar to which it is secured by a key. The object of the movable splint is to enable the surgeon, by removing one and substituting another, to employ which of them he pleases, according to the size of the leg, &c.; and also to enable the surgeon to adapt and treat with one trough only a greater variety of sizes than can be done with any known apparatus. There are other splints adapted to the outer and inner surfaces of the leg and ankle—these are also of different sizes, and have on the outside leather studs, through which the straps for binding them to the leg, &c. are passed. Another splint is adapted to the under side of the thigh, and made movable and secured to the thigh piece of the frame by means of a screw. And three other splints lined with leather are adapted to the sides and top of the thigh, and secured by straps, &c.

Claim.—"I do not claim the mode described of flexing and extending the framework; nor do I claim the mode of extending or shortening the splints as described. But what I do claim, is the combination of the splints (whether adjustable or not) with the hinged bar or framework; said bar being extended and flexed in substantially the manner described, and said splints being independent of the bar, and so constructed as to be readily attached or detached at pleasure, for the purpose herein described; the whole construction being substantially as herein set forth. I have applied the same principles of construction to the upper extremities, the modifications being only in form to suit the shape and motions of the upper limbs."

2. For an improvement in the *Straw Cutter*; E. Taylor, Rochester, Monroe county, New York, November 6.

The movable knife of this straw cutter is operated by having one

end jointed to a crank pin on the fly wheel, and the other to one end of a vibrating lever, by which a draw cut is given. At the junction of the knife and lever a connecting rod is jointed which extends down and is jointed to one end of a lever, turning on a fulcrum near the middle of its length, the other end being provided with a whetstone, which, as the knife descends, rises and rubs against the outer face of the knife, and sharpens it.

Claim.—“Having thus fully described the nature of my invention, what I claim therein as new, and desire to secure by letters patent, is the adjustable whetstone so arranged and combined as that it shall meet in its ascending angular motion the edge of the knife in its descending angular motion, thereby setting the edge in towards the straw-rest, and giving the edge of the knife an appearance much like that of the sickle.”

3. For an improvement in the *Truss for the Treatment and cure of Hernia*; Eliakim C. Darling, New Orleans, Louisiana, November 6.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the use of a continuous metallic band entirely encircling the body and fastening in itself, and of such materials as not to stretch by use, but of such malleability as to allow any person to shape it to themselves at pleasure; thereby doing away with the use of leather or other straps of stretching material.”

The pad and its appendages are connected with this metallic belt in the same manner as heretofore with the spring.

4. For a *Balance Crane for Raising and Weighing Heavy Bodies*; Louis Henry, Paris, France, assigned to Claudius Gignoux, New York city, New York, November 9.

“The nature of my invention,” says the patentee, “consists in combining with a lifting crane, a weighing apparatus, so that the articles that are raised by the crane, can be at once weighed, thereby facilitating the double operation.”

The mast of the crane instead of being supported at the top and bottom in permanent bearings, is connected with a standard, supported in the same manner as the mast of the ordinary crane, by means of links, and connected with a steelyard balance, so that the whole weight of the crane can be made to rest on the balance, and knife edges in links at the top of the mast.

Claim.—“Having thus fully described my improvements, and the operation of the same, what I claim therein as new, and desire to secure by letters patent, is the combination of the balance or steelyard with the lifting crane, substantially in the manner and for the purpose herein set forth.”

5. For an improvement in the *Grain Cradle*; Wm. A. Wood and John C. Loveland, Hoosick Falls, Rensselaer county, New York, November 9.

This is for making the teeth of metal tubes or partly of metal teeth and partly wood, instead of wood alone, and when made partly of wood and partly of metal, the hollow metallic part constitutes the extremity which is the most liable to bend.

Claim.—“What we claim as our invention and improvement, and desire to secure by letters patent, is the use of said hollow metallic teeth and hollow metallic parts of teeth; the metal being less liable than wood to relax and straighten.”

6. For improvements in the *Cotton Press*; Jedediah Prescott, Memphis, Shelby county, Tennessee, November 9.

The follower of this press is operated by means of two parallel levers jointed to the underside of it (one at each end) and to a carriage, that runs on truck rollers on the bed of the machine, and is worked by cords passing around pulleys and extending to a capstan. The ends of the box are let into grooves in the follower or platen of the press, and work up and down with it, and at the end of the operation they are lifted out of these grooves and liberated by two short levers that strike against projections on the frame—these levers are designated in the claim by the letter *z*. The lower edges of the sides of the box are jointed to the frame, and, when closed, are held in place by two bars, which are thrown up towards the end of the operation, by pins connected and moving with the platen.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is—1st. The combination of the inclined parallel levers with the horizontal carriage and rollers, arranged and operated in the manner and for the purpose set forth. 2d. The arrangement of the ends *d* of the box grooves in the platen, so as to rise and fall with the platen, and be liberated from it at the termination of the pressing.—3d. The combination of the levers *z* with the platen, arranged and operated in the manner and for the purpose above set forth. 4th. The manner of disengaging the bars from the box, by means of the pins upon the ascending ends of the box, in order to throw open the sides of the box, to tie and remove the bale.”

7. For improvements in the *Tide Mill*; John Gerard Ross, New York city, New York, November 9.

The wheel is placed in a race, at one end of which there is a tide gate hinged to a wall beyond the end of the race and shutting against either side of the race; and at the other end of the race there are two current gates, one termed the “inner current gate,” and the other the “outer current gate,” these are hinged to the ends of the race way wall and shut against a pier placed beyond the end, and in a line with the middle of the width of the race way. The current in passing along opens the “current gate” and after acting on the wheel passes out through the “outer current gate,” and on the return tide the pressure of water closes this “outer current gate,” which causes the current to pass around to that side of the tide gate opposite to that at which it entered on the rise of the tide, throws it against the opposite

side of the race-way, acts on the same side of the wheel as on the rise of the tide and passes out through the "inner current gate." The dam walls are formed with pits open at the sides for the free ingress and egress of the water to act on floating caissons which sustain the wheel and always keep it at the required elevation. The shaft of the wheel (or wheels) is connected with the frame work of the mill by bars radiating from the axis of a cog wheel, into which mesh the cogs of the master wheel.

Claim.—"First. I claim as new, and of my invention, and desire to secure by letters patent, the mode described of fitting the tide-gate I, at one end of a race-way, formed by an inner and outer dam-wall, in combination with an outer current-gate K, and an inner current-gate L, at the opposite end of the race-way; the whole constructed and operating substantially as herein described.

Second. I claim the mode of forming the dam-walls with pits, open at the bottom, to receive and float the caissons that carry the water-wheel; and the combination therewith of the described means for regulating, adjusting, and directing the ascent and descent of the wheel or wheels, substantially as the same are described and shown herein.

Third. I claim the combination of the described mode of fitting the gates and wheel, and making them act together in the manner described herein."

8. For an improvement in the *Smut Machine for Cleaning Grain*; Jacob Groat, Troy, Rensselaer county, New York, November 9.

This is for the addition of a reservoir or spout to the case, or concave, which surrounds the beater and rubber, into which the grain is thrown, and the discharge therefrom is regulated by a gate, so that the grain may be kept in the machine as long as may be necessary to clean it thoroughly.

Claim.—"Having thus fully described my improvement, what I claim therein as my invention, is, first, the regulating reservoir or spout, constructed as above described, in combination with the cylinder and concave, as herein specified."

9. For an improvement in the *Means of Removing Mud, Sand Bars, &c., from the Beds of Rivers, &c.*; Dennis Vermillion, Washington, D. C., November 9.

A mass of logs are put together in the form of a boat, to be moved down by the current, tide, or otherwise, and which from its great weight and strength will acquire great momentum. Iron breakers, sharpened at the lower end, pass obliquely through apertures in this mass, and extend down to the depth required to act on the obstruction to be removed. At the stern there is suspended a drag rake, connected with the boat by means of two arms that slide freely in apertures in the ends of a cylinder which is hung on appropriate journals; and for the purpose of raising this rake, cords extend from it to a windlass on the boat. The operation of the apparatus is this—The boat being put in motion by the current, or otherwise, is directed towards

the sand bank, or other obstruction, and the breakers and rake having been set to the required depth, the breakers cut up and loosen the sand, mud, &c., which is then raked into deeper water.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the combination of a bulk of square logs, resembling the hull of a vessel, the adjustable breakers and the rake with its oscillating cylinder and windlass; the whole forming an apparatus for removing sand or mud bars or shoals, or othersimilar obstructions to navigation, from the beds of rivers and other waters; said apparatus being (substantially) constructed, and operated, as herein above described.”

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10. For an improvement in the *Cultivator Tooth*; James Birdsell, Hamilton, Chester county, Pennsylvania, November 9.

The nature of this invention consists in attaching a separate cutter to the tooth of a common cultivator constructed in the ordinary way; the said cutter being so formed as to be turned to make the heel become the point, and vice versa. It is convex on the upper, and concave on the under side, and the latter rests on the ground, so that being reversible it will keep sharp until worn out.

Claim.—“Having thus fully described my improvement, I wish it to be understood that I do not claim a self-sharpening cultivator tooth, as that is known; but what I do claim as my invention, and desire to secure by letters patent, is the self-sharpening convex cutter constructed substantially as herein set forth, in combination with the cultivator tooth, in the manner and for the purpose described.”

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11. For an instrument for *Measuring Coats, Vests, &c, and for Drafting the same for Cutting*; John P. Combs, Trenton, Mercer county, New Jersey, November 9.

Two scales are jointed together and provided with a protractor, and to each of these scales there is a measuring tape attached by eyelet holes and buttons at given distances apart on the face of the scales and corresponding with the marked divisions thereon.

Claim.—“What I claim as my invention, and desire to secure by letters patent, are the jointed protractor, and the straps or measures, and attached with the screw and eyelet holes, as before described; by means of which all the angles necessary to be had, in order to insure a perfect fit, are easily and accurately obtained.”

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12. For an improvement in the mode of *Constructing Fire Places and Flues*; Daniel Hemingway, Leesburg, Harrison county, Kentucky, November 13.

The back of the fire place is vertical to a certain height, it then falls back about one foot inclining upwards to the height of the arch, and from this line it widens out on each side in a circular form, and contracts in the same manner to form the flue.

Claim.—“I do not claim expanding the flue above the throat; but what I do claim as my invention, and which I desire to secure by letters patent, is dropping the back of the fire place below the arch,

in the manner described, in combination with the expanding flue, substantially in the manner set forth."

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13. For an improvement in the *Horizontal Wind Mill*; Daniel Dennett, Centreville, St. Mary's Parish, Louisiana, November 13.

The wings or vanes of this mill are jointed to radial arms, and are suspended by cords to vibrating levers that pass through, and are jointed to, the shaft above the arms to which the wings or vanes are jointed, so that by this arrangement the moment one vane begins to make "back wind," (as it is termed,) it is blown down, and by its connection with the one on the opposite side of the shaft draws it up to catch the wind.

Claim.—"Having thus fully described the nature of my improvements in the horizontal wind-wheel, what I claim therein as new, and desire to secure by letters patent, is the manner herein set forth, of combining the motion of the two opposite vanes by means of cords, chains, or rods, by which they are connected to the end of a vibrating beam, substantially in the manner and for the purpose herein made known."

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14. For a machine for making *Tuscan or Leghorn Braid*; Elisha Fitzgerald, New York city, New York, November 13.

It is to be regretted that, from the necessary complexity of the mechanical arrangements, a description without drawings could not be made sufficiently clear. After the pieces of straw have been deposited in a box, the whole operation of taking each separate piece, introducing, bending it over, trimming off the surplus, and transferring and retransferring the pincers or nippers by which the pieces are held, and the completed braid delivered, is carried on, with the most beautiful regularity, without the hand of an attendant.

As the claim refers to, and is wholly dependent on the drawings, we are under the necessity of omitting it.

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15. For an improvement in the manufacture of *Lamp Black*; Gilbert Mini, Philadelphia, Pennsylvania, November 13.

The rosin or other material to be burned is put into a furnace which opens into a large room, without chimney or any other opening than the one communicating with the furnace.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, is the mode herein described of burning lampblack—that is to say, burning it in a confined building or room without a chimney or draught, substantially in the manner set forth in the above specification."

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16. For an improvement in the *Point for Manifold Writers*; Jesse K. Park, New York city, New York, November 13.

The "nature of this improvement consists in making a spiral flexible point, of either steel, platinum, gold or silver wire, or any other metal suitable for the purpose. Said spiral to form a cone and so

attached to the handle as to have a point within it to check the elasticity and prevent the point from yielding too much.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the manner in which I construct my point for manifold writing, by combining with the conical spiral wire point, the check point, in the manner described, and attaching them to a handle for the purpose described.”

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17. For an improvement in the method of *Preventing Chimneys from Smoking*; Joseph Gilbert, Frease's P. O., Stark county, Ohio, November 13.

Channels are made around the fire place, before the pilasters and fascia are put on, which communicate, by means of vertical channels in the stack, with the spaces between the floors and ceilings to conduct cold air to the fire place. The pilasters and fascia of the mantel are placed over these channels, thus forming the front thereof. The lower portion of the fascia of the mantel is brought to a feather edge, so as to form a horizontal longitudinal space behind the mantel communicating with the horizontal air channel in the breast of the chimney, through which space behind the mantel, the cold air passes from the said channels to the fire place.

Claim.—“I do not claim admitting the external air for the purpose of preventing chimneys from smoking, as that has been done before; but what I do claim, is the mode herein described of introducing the air—that is to say, between the mantel and the arch, in the manner and for the purpose described.”

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18. For an improvement in *Manufacturing Lard and Tallow*; H. A. Amelung, St. Louis, Missouri, November 13.

This process consists in extracting fat from fibrin, &c., by mechanical means, such as rollers, and discharging into a vat divided into an upper and lower compartment by a sieve, which permits the oil and fat to pass into the lower compartment, from which it is put into a warm water bath, to separate the oil and fat entirely from the fibrin, albumen, &c. And, in conclusion, the fat is put into a vessel heated by steam, to be cooked.

Claim.—“What I claim therein as new, and desire to secure by letters patent, is the process herein described of obtaining fat from the fibrin, &c. before it is cooked, and afterwards cooking the expressed fat in the manner described; by which the danger of injury to the lard, by cooking it with its impurities, is obviated, and a much purer article obtained, as well as a saving effected.”

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19. For an improvement in the machine for *Sowing Grain Broadcast*; Ezra Fisk, Fayette, Kennebec county, Me., November 18.

There is a cylinder placed at, and which closes up, the opening in the bottom of a hopper. This cylinder is grooved longitudinally, and in rotating, the grooves carry out the seeds, which would be thrown on the ground in rows, were it not that the frame, or “platform,”

which holds the hopper and cylinder, has a reciprocate movement communicated to it by spurs on the axle of the supporting wheels of the machine, and a spring, which casts the seeds broadcast over the surface of the ground. Along the lower edge of the hopper there is a brush for clearing the surface of the cylinder of the surplus seeds.

Claim.—“What I claim, is the combination of the vibrating grooved cylinder with the vibrating slide or platform, and also, in combination with the vibrating cylinder, the brush as described; said parts being arranged and operated substantially in the manner set forth.”

20. For an improvement in the *Wheat Fan or Winnowing Mill*; William Stanley, Jamestown, Guilford county, N. C., November 18.

Claim.—“I do not claim a spiral fan wheel, as that has been before used with winnowing machines; but what I do claim, is placing upon the same shaft two spiral wheels, so arranged and combined that the air shall be drawn in at both ends of the concave cylinder which surrounds them, and contracted and forced out at the centre upon the screens, or be used for any other purpose where a strong blast of air is required, substantially in the manner herein described.”

21. For an improvement in the *Cooking Stove*; James H. Lyon, Schenectady, New York, November 18.

The furnace of this stove is placed above the oven, and slides thereon, from front to back, by means of handles passing through the front of the stove, to regulate the baking in the oven.

Claim.—“I claim as my invention, the government of the heat of an oven during the process of baking, by combining therewith a movable furnace, situated immediately above said oven.”

22. For improvements in the *Mowing or Reaping Machine*; Wm. F. Ketchum, Buffalo, Erie county, New York, November 18.

In this machine, the grain is cut by means of vibrating cutters, projecting somewhat in the manner of saw teeth from one edge of a plate. The cog gearing which forms the connexion between this vibrating plate and the supporting wheels of the carriage, to which the whole mechanism is attached, is placed within the supporting wheels that have cogs on their inner peripheries, and are cased in to protect the mechanism.

For the purpose of bending in the heads of grain and holding them whilst being cut, there is an endless apron which passes over rollers at a proper height above the cutters.

Claim.—“What I claim as my invention, is the combination of the driving wheels with the cutters, in the manner described, by forming internal gear on the wheels, and inclosing all the driving gear inside of them by the construction and arrangement above set forth.

“I also claim the employment of an apron in combination with the cutters, for turning in the tops of the grain, as herein described.”

23. For an improvement in the *Machine for Separating Grain*

*from Straw*; Manning and Christopher Packard, Clarendon, Orleans county, N. Y., Nov. 18.

A belt, or apron, is made to pass over rollers, at the upper and lower ends of an inclined board, and above this there is arranged a succession of rotating beaters, the shafts of which are placed at equal distances apart from end to end of the inclined plane. These beaters are composed of bars parallel with the shaft, and arranged in an ellipsis around it, and the greater diameter of the first is placed at right angles to that of the second, the third corresponds with the first, the fourth with the second, and so on, throughout the series. The grain and straw from the thrashing machine is discharged at the top of these beaters at the bottom of the plane, and by their rotation, the straw is carried up and discharged at the top, and the grain thus separated falls into the apron, and is by it carried to a fan.

Claim.—“What we claim as our invention, and which we desire to secure by letters patent, is the combination and arrangement of the revolving oval racks for conveying the straw and separating the grain therefrom, operated in the manner set forth, or other mode substantially the same. We also claim the combination of the revolving endless apron, with the before described revolving oval racks, arranged in the manner and for the purpose set forth.”

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34. For improvements in the *Rotary Steam Engine*; Matthew Fletcher, England, Nov. 18.

The pistons of this rotary engine are attached to, and rotate with a drum placed within a permanent cylinder and eccentric thereto, the periphery of the drum being in contact with one part of the inner periphery of the cylinder. The outer face of the pistons are segments of circles equal in diameter to the inner periphery of the cylinder, and their inner edges are jointed to slides that play in radial grooves in the drum. As it is indispensable that the outer faces of the pistons, in their rotation, be kept concentric with, and therefore, their inner edge converging to the centre of the cylinder, their ends are connected with segments that rotate in an annular, formed by two rings or circles, concentric with the cylinder. And to prevent, in some measure, the friction produced by the centrifugal force which presses the pistons against the periphery of the wheel, a ring, or hoop is let into a groove in the face of the segments on the ends of the pistons, which binds them together and prevents the centrifugal action.

Claim.—“What I claim, is—1st, the concentric and eccentric motion, in conjunction with the jointed fliers or pistons, which causes the said fliers or pistons always to point to the centre of the cylinder, and keep the same radius as the cylinder. The eccentric motion, alone, would not carry out the fliers or pistons to form a true circle, if not in conjunction with the principle of jointed fliers.

“2d. I claim the method of taking the friction from the outside of the fliers or pistons, against the sides of the cylinder, occasioned by the centrifugal force, by means of the ‘ring or hoop’ which unites the fliers or pistons in manner substantially as described.”

35. For an improvement in the *Smelting Furnace*; Leman Bradley, Sharon, Litchfield county, Connecticut, November 18.

This consists in dividing the stack into two, three, or more compartments, by means of partitions, extending from the top to a point a little above the entrance of the blast. Into one of these divisions the coal only is put, and the usual charge of ore, coal, &c., in the others; and that part of the hearth which is below the coal division is elevated above the other portion, that the coal may be kept up to the blast, and permit the melted metal to descend below it. The patentee sums up the operations and the advantages in the following words, viz: "The greatest part of the charge being put in the compartment next to the headstone, the metal will rest on the boshes, and will not come down faster than it is melted by the blast—the principal part of which comes in through the body of coal in the chamber, from the blow-pipe; the combustion being thereby rendered perfect before the blast reaches the metal, a great saving of fuel is effected, and a better quality of iron is produced. The damper over the coal chamber is kept down during the operation, and the gases are allowed to escape through the chambers on the opposite side of the partition. The fuel in the chamber rests on the hearth, and cannot fall much below the blast. A small blast can also be thrown in on the opposite side of the furnace to the main blast, which is regulated at pleasure."

Claim.—"Having thus fully described my improvements, what I claim therein as my invention, and desire to secure by letters patent, is dividing the interior of the furnace stack into two or more compartments, by partitions, which descend nearly to the bosh of the furnace—the bosh being the same as that of the common blast furnace, except the elevated hearth; the whole being constructed, arranged, and combined, in the manner and for the purpose herein set forth.

"I also claim the hearth, raised above the common hearth, and with the bosh, so that the melted metal will fall below the blast, and the fuel be retained up to the blast, as set forth."

36. For an improvement in the *Press for Packing or Compressing Cotton*; Peter M. Wright, New York City, N. Y., November 26.

The follower of this press is carried down by means of connecting rods, jointed to the follower and to cogged segments, operated by pinions; and for the purpose of increasing the capacity of the press for larger bales, the rods are connected with the follower by means of notches (called by the patentee ratchets) in the rods, which fit into pins or wrists projecting from the sides of the follower.

Claim.—"I claim the method of increasing the capacity of the press, by prolonging the upper ends of the connecting rods or levers, in connexion with the ratchet as described."

37. For an improved method of making *Stereotype Plates*; Clement Davidson, Saratoga, New York, November 26.

Claim.—"Having thus described my improvements and their operation, what I claim as my invention, and desire to secure by letters

patent, is—1st. The joining the moulds in the manner described, or in any other substantially the same.

“2d. I claim constructing the casting pan in the manner described, with upright tubes at the sides thereof, through which the metal flows into the pan; and the cover having a cup formed on the top thereof, with holes through it into the pan: the whole being arranged in the manner and for the purpose described.

“3d. I claim the combination of the moulds, the floaters, or plates between them and the pans, in the process of stereotyping, substantially in the manner and for the purpose set forth; by which any convenient number of plates can be cast at one time, without danger of breaking the moulds, or injuring the face of the letters, by *dirt*, or *dross*, or *shrinkage*.

“4th. I claim the combination of the revolving and stationary cutters, for reducing and leveling the back of stereotype plates, as herein made known; and, in combination therewith, the springs or fingers for holding down the plates.

“5th. I claim the combinations of the chisels, constructed and arranged as herein described, with the ordinary leveling machine, in the manner and for the purpose above specified.

“6th. I claim, also, the revolving marginal cutters, for leveling the edges of stereotype plates, arranged and constructed in the manner set forth, in combination with the chiseling machine for finishing stereotype plates.”

Without drawings, or a description beyond the limits of this work, the nature of these improvements could not be indicated better than by the above claims.

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38. For improvements in the *Machine for Cutting Shingles*; Tillott Cole, Kent, Putnam county, New York, November 26.

In this machine, the knife for cutting the shingles is attached to a sliding gate, and the block of wood is put upon a platform, and, after the cut of a shingle, pushed up by the attendant, for another cut; and the block is gauged by means of two vertical eccentric rollers attached to, and moving with the knife gate. The eccentricity of these rollers is for the purpose of so gauging the block as to cut the butt alternately, from opposite ends of the block, by giving them half a revolution to each stroke of the knife, which is effected by an arrangement of levers jointed to the gate and pitman, that, by means of a hand taking into a ratchet wheel, turn a cog wheel connected with a pinion on each of the rollers.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is—1st. The combination of the eccentric rollers, for gauging the thickness of the shingle to be cut, with the knife gate, as herein described. 2d. In combination with the eccentric rollers on the vibrating gate, the arrangement of cog-wheels, ratchet, and levers, for rotating the eccentric rollers as described.”

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39. For an improvement in the *Hand or Bench Plane*; Levi Sandford, East Solon, Courtland county, New York, November 26.

A plate of iron is attached to the back side of the "throat," or rather the bed on which the bit lies, which receives the screw that secures the cap to the bit, to make a double iron, so that the same screw binds the two irons together and to the stock, the two irons being provided with elongated holes for the screw to pass through to admit of adjustment. And this same plate or block of iron attached to the stock, receives the end of a screw which extends up beyond the upper end of the bit, where the two are connected by a collar, so that by turning the screw, the bit can be set to any degree of cut required.

Claim.—"I am aware that a patent has been granted for a plane, in which there is a piece of metal secured to the back part of the throat of the plane, to receive a screw, by which the bite of the bit is regulated. And I am also aware that a screw has been used for drawing cutting tools in and out, at pleasure, to regulate the degree of bite; and therefore I do not claim these devices as my invention. But what I do claim as my invention, and which I desire to secure by letters patent, is the arrangement by which the piece of metal at the back side of the throat receives the screw that secures the cap embracing the bit; and, also, the set screw for the adjustment and moving of the bit; by which arrangement, the said bit can be set without moving the cap, as described."

40. For an improvement in the *Mortise Latch for Doors*; Wm. Wilson, Northampton, Hampshire county, Mass., November 26.

Claim.—"Having thus fully made known and described the manner in which I arrange and combine the respective parts of my cylindrical mortise latch, what I claim therein as new, and desire to secure by letters patent, is the manner of retracting the bolt by means of two slides, actuated by means of a toothed pinion—said slides receiving the horns of the bolt, and constituting two racks, formed and operating substantially as set forth."

Each of the two slides moves in opposite directions, and the horns of the bolt are back of a shoulder on the slides, so that the slide that moves backward by the turning of the pinion, which is on the spindle of the knobs, carries the bolt back, whilst the other is at liberty to move forward. By this arrangement, the turning of the knobs in either direction will move the bolt.

41. For an improvement in the *Cheese Press*; John Martin, Jr., Medina, Medina county, Ohio, November 26.

The piston of this press slides in a frame, the bottom of which, constitutes the bed of the press. The head of the piston is provided with a set of rollers, arranged around the counter, and the top of the frame is provided with a corresponding set. One end of a cord is attached to the head of a piston and passes around the two sets of pulleys, and then through a hole in the piston head to a windlass above. After the cheese has been put under the piston of the press, the windlass is turned sufficiently to suspend the whole press, and by the arrange-

ment of the cord to which it is suspended, the weight of the press continues to make pressure on the cheese.

Claim.—“What I claim as my invention, and which I desire to secure by letters patent, is the before described combination of the block, or frame, of the self-acting press, with the piston, cord, pulleys, and windlass, suspended and operating in the manner and for the purpose set forth.”

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*List of American Patents which issued in the month of December, 1841, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For improvements in *Machinery for Raising Sunken Vessels*; John Custis, Yarmouth, Barnstable county, Mass., December 10.

Frames are built on two floats, and these are connected together by means of several truss frames, leaving space enough between the two floats for the reception of the vessel to be raised, and the ends of the truss frames rest on the heads of jack screws. A chain, (or chains,) passes around the body of the vessel, below what constitutes the water line of a vessel, and is then connected with the truss frames by other chains in the manner fully expressed in the following

Claim.—“I shall claim the peculiar combination of the two truss frames extending between two opposite standards, each having depending chains with links, or hooks, by which, said truss frames may be alternately connected to the vertical chains which are attached to the horizontal chain extending around the vessel, or about the bottom of the same, as above explained, by which arrangement of the apparatus the vessel may be raised by bed screws, as described.

“Also, the combining with said truss frames, the horizontal chain whose ends are passed through loops, or strong rings, attached to it where it comes in contact with each side of the bow abaft the cut-water, by which disposition of loops upon the chains, the chains can be fitted to vessels of different sizes, and be caused to bind tightly around the bottom, so as not to slip over the same; the whole being arranged, constructed, and operating substantially as above explained.

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2. For a machine for *Turning or Bending the heel of Scythes, or that part which fits into the Snath*; Abel Simonds and A. G. Page, Fitchburg, Worcester county, Massachusetts, December 10.

The heel of the scythe is griped between a rest block, attached to the top of a bed plate, and a sliding gripping bar operated by a hand lever, arranged below the bed plate, and then that part of the heel which is to be bent, and which extends beyond the gripping bar and rest block, is bent by a bending lever jointed to the bed plate, and operated with a toggle joint lever connected with a sliding rack, the teeth of which are thrown into gear with a pinion by the lever which operates the gripping bar.

Claim.—“Having thus described our invention, we shall claim the combination of the bending lever with the gripping bar, and also with

the rest block, and operating the said bending lever, by the combined arrangement of toggles or progressive levers, rack bar and pinion, the whole being arranged substantially as herein set forth."

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3. For improvements in machinery for *Raising Blocks of Ice from a Pond*; Nathaniel J. Wyeth, Cambridge, Middlesex county, Massachusetts, December 10.

In this piece of mechanism there are two gigs, or vertically sliding frames, one for hoisting the blocks of ice from the water and depositing them on to the inclined railway, down which they slide to the other gig, or sliding frame, for letting down the blocks on to a car or sled.

The hoisting gig is provided with balance bars, jointed to the frame of the gig, which correspond with the rails of the railway, and they are so jointed to the frame as to have their greatest length from the fulcrum out towards the railway, so that the weight of the block of ice will preponderate and cause the balance bars to take the inclination of the railway.

Claim.—"I shall claim the application to the hoisting gig of the *balance bars*, constructed and operating substantially as above set forth. Also the combination of the depressing gig with the receiving railway; and the combining of the said depressing gig and receiving railway with the elevating gig; the whole being constructed, arranged, and operating substantially in manner and for the purposes hereinbefore explained."

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4. For improvements in machinery for *Raising Blocks of Ice from the Water and Depositing them on a railway*; Nathaniel J. Wyeth, Cambridge, Middlesex county, Massachusetts, December 10.

In this improvement I shall claim, elevating blocks of ice from a lower to a higher level, by means of the sled, in combination with the ascending and descending inclined planes and horizontal rails extending over the descending plane, and which horizontal rails receive the blocks of ice, when the sled passes down the rear plane, the whole being constructed, arranged, and operating substantially as herein above set forth.

Also, that arrangement of machinery or addition to the sled which is herein termed the *catch*, for the purpose of retaining the blocks of ice over the sled and preventing them from sliding down the inclined plane when they are received upon the slide rails of the planes, the same being constructed substantially as herein before explained.

Also, the method of connecting the inclined and descending planes and horizontal rails with the transportation railway, at any desirable station of the latter, by arrangement of curved slide and guide rails supported on a platform having railway wheels connected to it by which it may be transported from place to place as occasion may require, the whole being constructed and arranged on principles and in manner substantially as described. Also constructing the railway cars in the manner above set forth, with slide rails arranged on their

bottoms and guide rails on their sides, and connecting those of each car by the hinged ends, each having a small lapping rail upon it, which extends over that in contiguity with it, and by means of which any two cars may be united, whatever ends of the same are brought together, the whole being for the purpose of sliding the blocks throughout the train and leading the same thereon and unloading the same therefrom as herein before described.

Also curving the guide rails and commencing them in rear of the slide rails as described, for the purpose of causing the ice to resume its proper position on the sled to pass up the inclined plane, should the ice by any accident have been forced over the side of one of the runners more than that of the other.

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5. For improvements in *Machinery and Railway Cars for discharging Blocks of Ice from Cars and depositing them in Store Houses*; Nathaniel J. Wyeth, Cambridge, Middlesex county, Massachusetts, December 10.

Claim.—“Constructing cars for the transportation of ice, with the elevating lever bars, which discharge the blocks of ice out of the sides of the cars, the said lever bars being elevated by bent levers (or other suitable means,) as described, and combining said lever bars with the slide rails of the cars, and with the tables or platforms arranged by the sides of the cars, and upon which the ice is received when discharged from the cars, the said tables being constructed on the principles herein before mentioned. I also claim the arrangement of the slide rails,—so that they may be elevated above the surface of the table, the whole of the above parts claimed being constructed and operating substantially in the manner as I have herein before set forth.”

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6. For an improvement in *Water Wheels*; John L. Smith, Salina, Onondaga county, New York, December 10.

Two of these wheels are put on a horizontal shaft, one on each side of the trunk or tunnel through which the water is applied to the wheel, the face towards the tunnel being open for that purpose. The apertures or issues for the water extend from the shaft to the outer rim, which is scalloped for that purpose, and are formed by the forward edge of one bucket, and the back edge of the other, these being placed diagonally for this purpose. And to the back edge of each of these buckets there is a flanch radial in its length, and parallel with the shaft in the direction of its width, which extends to the inner face of the wheel, or to the floor.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the mode of constructing the bucket as set forth, namely, by forming it with a flanch on the inner face of the wheel, extending from the hub, or centre, to the circular scalloped rim, and attaching its outer edge to said scalloped rim, all as before described

7. For an improvement in the *Smut Machine for Cleaning Grain*; John D. Beers, Philadelphia, Pennsylvania, December 10.

A rotating fan is placed in a horizontal cylinder open at each end near the shaft, for the admission of air, and the cylinder is provided with conveyors placed diagonally on the outer surface, and communicating with the inside by means of slots through which the grain is forced by the current of air into them, and at one end they communicate with a semicircular conduit on one of the heads, through which the dust, chaff, &c., is discharged. The grain is fed into the cylinder through an inclined trunk connected with the cylinder by means of a rule, or other joint.

Claim.—“What I claim therein as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the cylinder, the conveyors, and the openings therefrom, into and through the conduit or tubular space on the head of the cylinder, for the purpose herein fully explained and made known. I claim also the manner of feeding the grain into the cylinder, containing the revolving vanes, or beaters; the same being introduced through an inclined trunk or pipe furnished with a rule or other analogous joint so as to give any desired elevation thereto, and so that its inclination may be graduated to the nature of the grain and the velocity of the motion of the fan; and I likewise claim the mode of regulating the winnowing of the grain in its discharge from the cylinder, according to the intensity of the blast produced by the vanes, by means of a discharge tube furnished with a graduating joint, in combination with the vanes; by means of which arrangement, the same blast is made to winnow the grain, both in the feeding and discharge tube, substantially in the manner herein made known.”

8. For an improvement in *Carriage Springs*; R. B. Brown, Essex, Chittenden county, Vermont, December 14.

At the bottom and on each side of the body of the carriage, there are two helical springs wound on a bar; they are held between permanent blocks, and the end of sliding rods connected with straps attached to each end of a grasshopper spring; and a roller attached to each end of the carriage body frame rests on these straps, so as to render available the force of the grasshopper and the helical springs.

Claim.—“What I claim is the arrangement of the helical springs, rods, straps, and rollers, in combination with the grasshopper springs, for the purpose and in the manner described.”

9. For an improvement in *Tuyeres for Forges*; Riverius C. Stiles, and Joseph S. Graves, East Bloomfield, Ontario Co., N.Y., December 14.

Two pyramidal tubes project from the top of the wind chest, the space between them being sufficient for the bed of the fire, and the apertures for the discharge of the wind being near the top of the pyramids and in a direction towards each other, so as to concentrate the blast between the two pyramids.

Claim.—“What we claim is combining with a wind chest arranged as described, two or more tubes, or two or more apertures inclined towards each other, so as to produce a concentrated blast.”

10. For an improvement in the *Horizontal Double Acting Suction and Force Pump*; Joel Farnam, Stillwater, Saratoga county, New York, December 14.

Claim.—“I am aware that pumps have been made and patented with two pumps or channels placed at the side of the cylinder and extending from top to bottom, separated by a partition extending from end to end, and provided with valve seats, and cups, at top and bottom, or at bottom alone, and therefore I wish it to be understood, that I do not claim these modes of arrangement in this application.— But what I do claim as my invention, and desire to secure by letters patent, is the arrangement of the trunk, as above described, on each side of a partition placed equidistant between the two ends of the cylinder, each one communicating with that end of the cylinder nearest which it is placed, and provided with cups and valves above and below the two trunks, substantially as herein set forth.”

11. For an improvement in the *Manner of Combining a Coking Oven for Coking Bituminous Coal, with Boilers for Generating Steam*; Reuben Mc Millen, Middlebury, Summit county, Ohio, December 14.

Claim.—“I do not claim to be the first that has combined an oven for coking with a boiler or boilers for generating steam, with the intention of economizing heat, but what I do claim as new in my apparatus is the method of applying heat in the coking of bituminous coal, and of coking the same by means of an oven, or ovens, consisting of two or more compartments, divided from each other by close partitions, and to which compartments the coal is supplied, and its combustion and coking regulated as set forth, the same being combined with the boiler, or boilers, as specified, and the whole being constructed and operating substantially in the manner described.”

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*Decision in a suit, brought by John B. Emerson, in the Circuit Court of the United States, for the infringement of his patent for a Submerged Wheel with Spiral Propellers, by Hogg & Delamar.*

This was an action for an alleged infringement of a patent granted to the plaintiff for a submerged wheel, with spiral paddles, intended to propel vessels. The defendants conduct the Phœnix Foundry, in the city of New York, and had fitted various vessels with “Ericsson’s propellers.” The principal question in the cause was, whether these propellers, claimed to have been patented by Mr. Ericsson, were substantially the same as the wheel patented by the plaintiff.

The plaintiff, Mr. John B. Emerson, produced and read to the Jury a copy of his letters patent, dated 8th March, 1834. He proved, by Dr. Jones, that, at the time of filing his specification, he deposited in the Patent Office a drawing of the wheel, and also a model. The original specification, drawing, and model, were destroyed by the fire which consumed the Patent Office in December, 1836.

The counsel for the plaintiff then produced and offered to read a

certified copy of a drawing made by the plaintiff, and filed in the Patent office on the 28th February, 1844; this was objected to by the defendant's counsel, on the ground that the specification did not refer to any drawing, and that none had been annexed thereto—this objection was overruled, and the drawing was put in evidence.

The deposition of Dr. Jones, of Washington, was then read, by which it appeared that the plaintiff came to that city in March, 1844, and had with him the model of his improved wheel; that Dr. Jones was consulted by him, and then advised him that the drawing filed in February was imperfect, and an inaccurate delineation of the wheel; and that thereupon, Dr. Jones prepared a new drawing, with references, which was sworn to by Emerson, and filed on the 27th March, 1844. The counsel for the plaintiff then offered to put this corrected drawing in evidence. The counsel for the defendants objected, upon the ground that the Commissioner of Patents had no right to receive and file more than one drawing, and that by the filing of the drawing made by Emerson in February, the power conferred by the Act of 1837 had been exhausted. The Court overruled the objection, and the second drawing was put in evidence.

The counsel for the plaintiff then produced the model of a ship, with the propeller wheel, patented by the plaintiff, and then read the deposition of Charles Robinson, who deposed that he had made the said model in the year 1837, in New Orleans, and that it had been publicly exhibited for a year, in the Merchants' Exchange of that city, and from thence was taken to the plaintiff's ship yard.

The plaintiff's counsel then called William Serrell, who testified that he was a civil and mechanical engineer. Being shown models of the plaintiff's wheel, and of Ericsson's propeller, he stated that he had examined them, and had been forced into the conclusion that they were essentially the same.

This witness was subjected to a very long and minute cross-examination, which strongly exhibited his accurate and scientific acquaintance with the principles of practical mechanics. He stated, in substance, that the two machines were substantially the same in mechanical construction and action; that he could construct the plaintiff's wheel from his specification. He went into a detailed explanation of the specification, and said, that, taking it as a whole, he considered it sufficiently disclosed that which the inventor intended to construct.

The plaintiff's counsel also called James P. Allaire, who testified that he had been engaged for many years in making steam engines and other machinery; that "Ericsson's propeller" was identical in mechanical construction and effects with the plaintiff's wheel. He examined the specification, and testified that he could from it construct a wheel similar to the models produced in Court.

John C. Kiersted testified that he was a practical mechanic, and that, taking the specification, with either of the drawings filed by Emerson, he could construct a wheel similar to the models. He also proved that the defendants had made and applied "Ericsson's propellers" to a large number of vessels.

Stephen E. Glover testified that he was acquainted with Ericsson's propeller; that he had been interested in his patent, and that the charge for the use of his propeller was three dollars per ton for large vessels, and two dollars and fifty cents per ton for those of a smaller class.

The counsel for the defendants admitted that they had applied "Ericsson's propellers" to six vessels, each of 150 tons, and to one vessel of 340 tons.

The counsel for the defendants then called Dr. Dionysius Lardner, who testified that, before the date of the plaintiff's patent, he had seen propellers in England which had been patented by Mr. Perkins, and also by Mr. Smith. Models of them were produced, but the witness admitted that they differed substantially from the plaintiff's. He testified that the specification was vague and indefinite, and that he could not, from its directions, construct a wheel such as the plaintiff claims to have patented.

The deposition of Charles M. Keller was then read. He testified that he was a clerk in the Patent office; that he had officially examined the two patents of Emerson and Ericsson; that, in his opinion, they were different, and did not conflict; and that he had made a report to that effect to the Secretary of the Treasury.

James J. Mapes and William A. Cox testified that they were consulting engineers, and that they had read the plaintiff's specification; that it was vague and indefinite, and that they could not, from its directions, construct the wheel claimed by the plaintiff. Upon cross-examination, these witnesses stated that they were not practical mechanics.

Joseph Belknap, a draughtsman in the employ of Dunham & Co.; James Cochran, second engineer of the steamer Princeton; and George Birkbeck, jun., a person in the employ of the defendants, stated that they could not, from the specification alone, have constructed the wheel; but that, with the aid of the corrected drawing made by Dr. Jones, they could have done so.

The Court charged the jury, that the patentee is bound to file a specification of his discovery, which shall apprise the public of his invention without ambiguity or uncertainty; that, if they shall find that the plaintiff originally filed drawings, so that all persons might have examined them, and that such drawings were similar to those produced in the trial, then they might come in aid of the specification. He directed the jury to view it as the whole specification, and gather from it what the plaintiff intended to claim. His Honor then examined the terms of the specification in detail, and reviewed the testimony of the witnesses. He instructed the jury, that they must construe the language as addressed to men skilled in this branch of art—and if a competent mechanic could, from it, have constructed the wheel, it is sufficient. If such a mechanic could not, from the specification, have constructed the machine, then the plaintiff must fail, unless he can help it out by the drawings; that these must be shown to have been filed with his original application; that in this case, the Patent Office and its contents having been destroyed by fire, he is

compelled to supply the evidence in the best way he can. The Judge then reviewed the evidence as to the drawings filed in 1844. He further instructed the jury, that it had been contended that Emerson had abandoned his patent to the public by non-use; that this might arise either from positive abandonment, or might be implied from circumstances—and if the jury should find that he had relinquished his right, then he could not maintain this action; that a patentee cannot lie by an unreasonable time, and allow his invention to go into use. The Judge then reviewed the evidence upon this point.

He further charged, that it did not appear to be denied, that if the plaintiff's patent was valid, that the defendants had infringed it; that the jury were bound, if they found in favor of the plaintiff, to give him a verdict for his actual damages; that in some cases the Court had instructed the jury, that they might, in addition, give damages to compensate the plaintiff for the expenses of the litigation—but that, in the present instance, he thought they ought not to find beyond the actual damages proved. He repeated, that the great question in the cause was, had the plaintiff established his right to the wheel commonly known as "Ericsson's propeller?"

The jury found a verdict for the plaintiff for 3,575 dollars and six cents, costs. It is stated that, of the jury, eight were practical mechanics.

Lond. Jour. of Arts & Sci.

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*Opinion of the Judges of the Circuit Court of the United States in relation to Sales made by Inventors previously to taking out Patent Rights.*

It has heretofore been held in the Patent Office that, under the seventh section of the law passed on the 3d March, 1839, the sale of a newly invented article by the inventor, or with his consent, before he applied for a patent, would not invalidate it, excepting such sale had been made for more than two years prior to such application, or excepting on proof of the abandonment of such invention to the public. But by a letter just received from an intelligent gentleman in New York, it appears that, on the 13th instant, in the circuit Court of the United States, in the case of James Wilson *vs.* Austin Packard, it was in evidence that Wilson had sold a stove, the right to which was in controversy two months prior to his application for a patent therefor. On this testimony it was ruled by Judges Nelson and Betts that, if the inventor sells the article which he has invented in the usual way, or if he authorizes another to sell it, he abandons it to the public. That the sale, in the usual way, in a single instance, is a dedication of it to the public. That it is not a question whether the inventor intended to abandon it to the public, but merely what he has actually done. That the idea that a person can sell the thing invented without an abandonment to the public is an absurdity. That if the jury was satisfied that the plaintiff had thus sold, in one instance, before he applied for his patent, they should find for the defendant.

It is to be hoped that an appeal from this decision may be made to the Supreme Court, in order that it may be either confirmed or re-

versed. What was the intention of those who framed the section of the law in question is well known to the writer of this article: in many instances men had labored long and exhausted their means in bringing a machine to perfection, and, by selling this individual instrument, they could procure money enough to enable them to obtain a patent; but, under the then existing laws, such sale amounted to a forfeiture of their rights. It was really supposed by the uninitiated that the law had been changed in this particular, but it now appears that the attempt to do so was a failure, and that the Commissioner of Patents and others filling important stations in the Patent Office have not only misconstrued the law, but have afforded advice and information to inventors which have been destructive of their interests. Whatever may be the final result, should the question be carried up to the Supreme Court of the United States, the only safe course now to be followed by inventors, will be for them carefully to abstain from making any sale before completing their applications in the office.

Since the foregoing was written a further communication has been received from New York, written by a gentleman of the Bar, from which it appears that Judge Nelson charged the jury that the patent was equally avoided by the sale of the stove, on the part of the applicant, *after he had completed his application, but prior to the issuing of the patent.* It is not intended, in the present communication, to enter into any argument respecting the correctness of the instructions given to the jury by the Court. It frequently happens that months and sometimes years elapse between the time of making the application and the completion of the grant. In the case of Wilson's patent, this had extended to full three years, and during this period a number of his stoves had been sold. It is not known to the writer that a legal decision adverse to the safety of so selling had been ever made in our courts. The instructions given by the Patent Office and the words of the Patent law, as well as many decisions under the act of 1793, and that now in force, have quieted the minds of inventors respecting their right to make sales after their applications were before the office; but now all is uncertainty, even on this point, and the validity of a large proportion of the existing patents put in jeopardy.

T. P. J.

National Intelligencer.

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## ENGLISH PATENTS.

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*Specification of the Patent granted to THOMAS CLARK and CHARLES CLARK, of Wolverhampton, in the County of Stafford, for Glazing and Enamelling Cast Iron Hollow Ware, and other Metallic Substances.*—Sealed May 25, 1839.

To all to whom these presents shall come, &c., &c. The nature of our said invention consists in so cleaning and preparing the surface of the inside of the cast iron surface to be enamelled, that when the proper enamelling material is placed upon it and exposed to a proper heat,

the enamel will remain attached to the meta and become properly glazed, so as to withstand the ordinary heat to which saucepans and other the like ware are exposed, without cracking or coming off.— And in further compliance with the said proviso, we, the said Thomas Clark and Charles Clark, do hereby describe the manner in which our said invention is to be performed by the following statement thereof with reference to vessels such as cast iron saucepans (that is to say):—

*Preparation for the Vessels.*—Before the application of the enamel, the vessel of cast iron must be well cleaned in the following manner: mix with sixteen or twenty gallons of water, as much sulphuric acid as will render the water sensibly acid to the taste; put the vessel in and let it remain three hours, or even more; then take it out and scour it with sand, wash it twice in clear spring water, and lastly immerse it for five minutes in boiling water; take it out and wipe it perfectly dry, and it is then fit for the application of the enamel, which is composed of two coatings, first a composition for the body, and secondly a composition for the glaze. The first composition is made as follows: one hundred pounds of flint, calcined and ground fine, added to fifty pounds of borax, ground fine also; calcine these together till they are perfectly fused, let them cool, and then take forty pounds of the above, and five pounds of potter's clay, and grind them in water together, and bring them to such a consistence as when the vessel is washed with it that a coating of about one sixteenth of an inch is left in it, forming the first coating, or body, to support the glaze; let this set, which it will do sufficiently in from five to ten minutes, if kept in a warm room. And then the following, or second composition, must be very evenly sifted over it whilst it is yet moist: one hundred and twenty-five pounds of white glass, made without lead, twenty-five pounds of borax, twenty pounds of soda; these must be pounded fine together, and then perfectly vitrified in a crucible, then cooled and ground very fine in water, and afterwards dried; then take thereof forty-five pounds and one pound of soda, mix them together well in hot water, stirring them well; then dry them in a stove, and a fine powder will be produced; when this powder has been very evenly sifted over the first composition, the vessel must be put in a stove at a temperature of two hundred and twelve degrees of Fahrenheit to dry it, after which the composition is fired, by placing the vessel in a kiln, or moufle, such as the China manufacturers use for firing enamel colors; the kiln is brought to a sufficient heat to fuse the glaze, the vessel must then be first heated gradually at the mouth of the kiln, and then put in the full heat till the glaze is fused; it is then taken out to cool gradually. Now, whereas we claim as our invention, the enamelling and glazing of cast iron, as hereinbefore described, so as to enable vessels, so enamelled, to bear the heat to which saucepans, and such like cooking vessels, are ordinarily subjected without cracking or splitting off.—In witness, &c.

*Enrolled November 25, 1839.*

*Disclaimer.*—Entered by the said Thomas Clark and Charles Clark, pursuant to the provisions of an Act passed in the 5th and 6th years

of the reign of his late Majesty King William the Fourth, entitled, "An Act to amend the law touching Letters Patent for Inventions:"

We, the said Thomas Clark and Charles Clark, do hereby declare that since the granting of the said letters patent and the enrolment of the specification thereof, we have been advised that it is doubtful whether the said invention is applicable to other metallic substances than cast-iron, and for this reason we, the said Thomas Clark and Charles Clark, do hereby disclaim the words, "and other metallic substances," in the said title of the said patent.—In witness, &c.

Rep. Pat. Inv.

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*Specification of the Patent granted to JOHN SWINDELLS, of Manchester, in the County of Lancaster, for several Improvements in the Preparation of various Substances for the purpose of Dyeing and Producing Color, also Improvements in the Application and Use of several Chemical Compounds for the Purpose of Dyeing and Producing Color not hitherto made use of.*—Sealed June 12, 1844.

To all to whom these presents shall come, &c., &c. One part of my improvements in dyeing and producing color consists, when madder, madder-root, or munjeet, is made use of to produce some given color, in preparing the madder as follows:—I take any given weight of my madder, and, when reduced to a fine powder, I mix the same with as much of a solution of caustic ammonia, potash, or soda, as will thoroughly carbonize the yellow or fawn coloring matter therein. Different kinds of madder require different proportions. What is called best French madder requires one-eighth part of its weight of caustic alkali, or of ammonia, as much of the solution as will be equivalent in saturating a given weight of an acid, as the one-eighth of potash. I thoroughly mix any of these solutions with the powdered madder, and expose them to heat not exceeding 175° Fahrenheit: this, when dissolved in water, will be ready to operate with in dyeing or forming madder, lakes, or pinks; or the madder may be first treated with sulphuric acid, as in making guarancine, and the alkali afterwards applied, which will not then require to be operated on by heat, but simply dissolved in a solution of any of the alkalies, or their carbonates, or other salts thereof; but I prefer, for any of these purposes, caustic solution of ammonia as producing the best effects. In dyeing cottons or linens with this prepared madder, or with the common kinds, as also with other vegetable matter, I prepare the cotton for receiving the color as follows:—After it has been bleached or thoroughly cleansed from impurities, I steep it for some hours in a solution of gelatine or albumen (the strength of solution which I prefer is a specific gravity of 1.04.) After removing from this, I pass the goods into a strong solution of tannin for twelve hours. I then wring them out, and dry thoroughly, either in the air or a stove. This process may be repeated or not, according to the depth of color required.

I then go through the remainder of the processes of dyeing in the usual manner.

My next improvement consists in preparing, for dyeing blues and similar colors, the compounds of cyanogen and ammonia, as follows: My first improved method consists in preparing a substitute for the hoof and horn, and other animal materials usually made use of.—This I accomplish by grinding to a fine powder or paste common coal, cannel coke, or charcoal, or any other carbonaceous matter, and mixing therewith a solution of gelatine, albumen, or a mixture of each, and, thoroughly drying the compound, I use it in the same way as the hoof and horn is now made use of. My second improved method of producing the compounds of nitrogen, namely, cyanogen, or prussic acid, and ammonia, consists in combining nitrogen gas or the oxides of nitrogen with carbon, as follows:—If nitrogen be made use of, it may be produced from the atmosphere, or from any of its compounds or mixtures, passing it through heated carbonaceous matter of any description; but I prefer charcoal or coke, so as to form oxygen, (if it be atmospheric air,) into carbonic acid. To accelerate the process, I propel or force the mixed nitrogen and carbonic acid through lime, by means of appropriate machinery, either in a semifluid state or in the state of hydrate, or it may be passed through solutions of any alkali or alkaline earth, so as to combine the whole of the carbonic acid therewith, and also condense any aqueous vapor that may be present; nitrogen gas, moderately free from other gases, will then remain.—This nitrogen I then pass through charcoal, or any carbonaceous matter previously saturated with potass or soda, kept at a full red or approaching a white heat, in a perfectly close retort, or any other convenient apparatus, until the required quantity of cyanide is produced. If ammonia is to be produced, I pass the nitrogen gas, together with one-fourth its volume of steam or aqueous vapor, through charcoal or other carbonaceous matter at a red heat, and condense the ammonia so produced by the usual process or processes, or atmospheric air may be made use of along with aqueous vapor, and passed through heated carbonaceous matter at a red heat, either in close or open vessels.—If the protoxide, deutoxide, or nitrous vapor be operated on for the production of cyanogen, I proceed, as before described, in operating with nitrogen gas; or the process of separating the oxygen may be dispensed with, and by making due calculation of the quantity of oxygen in the compounds of nitrogen operated on, adding potass or soda sufficient to combine with the carbonic acid which will be produced in the process when passed through the heated carbonaceous matter. In forming ammonia, or its compounds, from the oxides of nitrogen or nitrous vapor, I pass them, in conjunction with their own volume of steam, through charcoal or other carbonaceous matter at a red heat, either in close or open vessels. But if a compound of carbon and nitrogen, namely, cyanogen, is to be formed or produced, the apparatus containing the heated carbonaceous matter must be air-tight. I wish this to be minutely attended to, as it is necessary to the process of producing cyanogen to exclude oxygen, carbonic acid, or aqueous vapor, and constitutes the difference betwixt a process some time ago

patented, for producing cyanogen by pumping atmospheric air through heated charcoal, and my process, as before described.

My improvement, in applying several chemical salts or compounds in dyeing or producing color, consists in using or operating on a class not hitherto used for these purposes. In dyeing or producing color from the cyanides, ferrocyanides, or other compounds or salts of cyanogen, I separate the acid required from its combination with barium, strontia or calcium; but of these I prefer the salt of barium, which I operate on by precipitating the barium by its equivalent quantity of sulphuric acid, diluted with as much water as may be necessary to produce the required strength of acid to be made use of. My improvements also consist in the application of the chromates and bichromates of barytes, strontia, and lime, whose bases I also separate by an equivalent proportion of sulphuric acid and water according to the strength of the solution required. In operating on manganic salts, I make use of the manganate of barytes, strontia, or lime, and separate the base by an equivalent quantity of sulphuric acid and water, as already described in preparing chromic acid. The solution of the acids of chrome and manganese, when separated from their bases, I apply in raising, dyeing, and oxydating various colored fabrics.

I claim therefore as my invention—

Firstly, the use of ammonia, or other alkalies, for preparing a madder dyeing liquor.

Secondly, I claim the process of preparing cotton or linen by subjecting them to the action of gelatine or albumen and tannin.

Thirdly, I claim the method of preparing materials for the manufacture of cyanogen or prussiates by using gelatine or albumen mixed or ground together with carbonaceous matter of any description.

Fourthly, I claim the production of cyanogen and its compounds by operating on nitrogen gas, after having removed any other gas or aqueous vapor therefrom, before introducing it to the heated carbonaceous matter.

Fifthly, I claim the production or manufacture of cyanogen or its compounds by operating on the oxides of nitrogen or nitrous vapor, however procured, by bringing them in contact with heated carbonaceous matter, either after having separated the oxygen or without separating it.

Sixthly, I claim the production or manufacture of ammonia, or its salts, by operating on the nitrogen of the atmosphere or any other oxides of nitrogen, in conjunction with aqueous vapor, and passing the same through heated carbonaceous matter.

Seventhly, I claim the application or use of the cyanide, ferrocyanide, or chlorocyanide, or any other combination of cyanogen and barium, strontia or calcium, in dyeing, printing, and producing color.

Eighthly, I claim as new the use and application of chromate or bichromate of barytes, strontia, or lime, for the purpose of dyeing, printing, and producing color.

Ninthly, I claim also the use and introduction of the manganate of barytes, strontia, and lime for the same purposes.—In witness, &c.

*Enrolled December 12, 1844.*

Rep. Pat. Inv.

To WILLIAM IRVING, of Lambeth, engineer, for improved machinery and apparatus for Cutting and Carving Substances to be applied for Inlaying and other purposes.—[Sealed 25th November, 1843.]

This invention consists in certain improved constructions or arrangements of machinery, having a revolving cutter, by means of which, in conjunction with a movable table, tablets of wood and other materials can be cut away, carved, countersunk, and perforated, in various ornamental forms, with great facility, for the production of inlaid devices, gothic tracery work, and other kinds of ornaments hitherto usually wrought by hand.

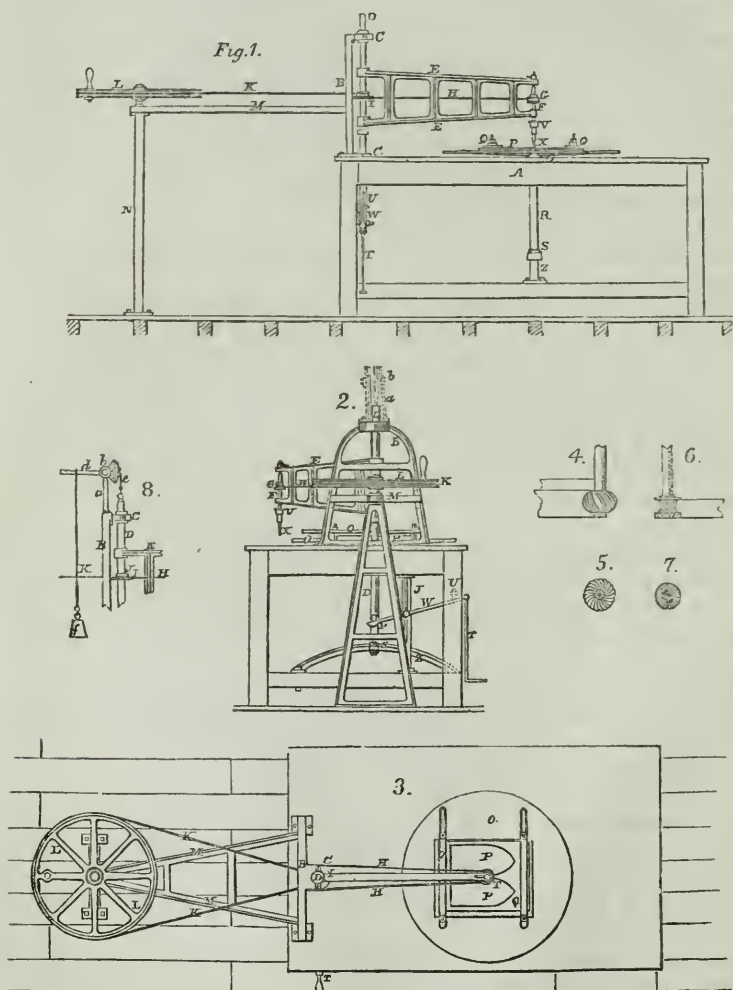


Fig. 1 represents a side elevation; fig. 2, an end elevation; and fig. 3, a horizontal view of the machinery. *A A*, is a bench, or table, for supporting the several parts of the machine; *B, B*, is a standard, or bracket-frame, firmly fixed to the said bench; which frame is provided with plummer-blocks and bearings *c, c*, to receive a spindle *D*. *E*, is a forked frame, or swinging arm, firmly fixed upon the spindle *D*; and the other end of the arm *E*, is furnished with suitable bearings, which carry, in a vertical position, a spindle *F*. The lower end of this spindle *F*, is formed to receive a chuck *V*, or other suitable contrivance, for attaching and holding securely, the tool, drill, or cutter *x*, or such other cutter as may be required; and upon the spindle *F*, near its upper end, is fixed a conical pulley *G*, having grooves of different diameters, for the purpose of determining the velocity with which the spindle shall be made to revolve. This pulley is designed to receive an endless band or cord *H*, which passes round the lower part of a similar pulley *I*, running loosely upon the spindle *D*; the upper groove of the pulley *I*, is made to receive another endless band or cord *K*, that passes around a wheel or drum *L*, supported by a standard or frame *N*, which is connected, by a similar frame *M*, to the standard *B*; but the band *K*, may be driven by any other means. *O*, is a horizontal movable table, mounted upon a vertical shaft, *R*, which passes through the bench *A*; its lower end being supported by, and turning freely upon, a step or bearing *S*, in the arch *Z*, fixed to the framing of the bench. The tablet or slab of wood, or other material, intended to be wrought by the cutter *x*, is to be placed upon the turning-table, as at *P*, and made fast thereon by screwed clamps. At the left-hand end of the bench *A*, there is a vertical bar *J*, made fast to the wood framing, in which there is a fulcrum-pin for the lever *W*, to turn upon; one end of this lever *W*, is formed into a concave socket to receive, as a step, the lower end of the spindle, *D*. before mentioned; and the other end of the lever is connected, by a joint, with a treadle-rod *T*. This treadle-rod and lever are for the purpose of raising, when required, the spindle *D*, with the forked frame *E*, carrying the drill. *U*, is an adjustable screw, set in the leg of the bench, as a stop to the lever intended to regulate the descent of the spindle *D*, with the frame *E*, in order that the cutter *x*, shall not penetrate deeper into the material, or substance *P*, than may be desired.

Fig. 3, and the part dotted in fig. 2, represents another arrangement for raising and lowering the spindle *D*, with the forked frame and drill, instead of the lever and treadle-rod, before described: this arrangement is used when the carving of variable relief, such as foliage, figures, &c., is required to be executed.

Upon any convenient part of the standard *B*, is fixed a frame *a*, with bearings *b, b*, to receive and support the axle of a quadrant *c*, which has a lever *d*, attached to its centre. From the periphery of the quadrant *c*, is suspended, by a chain *e*, or other suitable contrivance, the spindle *D*, carrying the forked frame *E*, with the drill. To the lever *d*, a weight *f*, is suspended by a rod, or other convenient means, hung in any of the notches provided in the lever for that purpose; which weighted rod acts as a counter-balance to the spindle *D*,

and the several parts attached thereto ; thus enabling the cutter *x*, to be raised or lowered with the greatest facility and precision ; all the other parts of the machine, and their action, being the same as hereinbefore described.

Fig. 4, is an elevation, and fig. 5, an under side or end-view of a tool or cutter, for cutting or carving a semi-circular or quarter-round hollow, for mouldings, gothic tracery, &c. ; fig. 6, is an elevation, and fig. 7, an under side or end view of a tool or cutter, for cutting or carving a bead and fillet, or astragal. These are only two examples of cutters, but, of course, a great variety may be employed, and these must depend upon the form of the edge of the recess intended to be cut or formed ; as any and every variety of rounds and hollows, ovolos, ogees, &c. ; separately or combined, may be executed, not only in straight lengths, but to the form of any regular or irregular curve that may be desired.

The mode of cutting or carving with this machine is as follows:— Upon the revolving table *o*, the tablet, slab, or piece of wood, or other material *p*, to be cut, or carved, is fixed ; and on its upper surface, when desired, is placed a template or pattern *q*, (formed of iron, brass, or other approved material,) of the design required to be cut or carved ; and the two are firmly held upon the table *o*, by cramps, or cramping-bars, as shown. Motion being given by any convenient power to the wheel or drum *l*, or communicated by any other means to the band or cord *k*, the pulley *i*, will be made to turn rapidly upon the spindle *d* ; by which means the band or cord *h*, passed round the pulley *g*, will cause the spindle *f*, carrying the cutter *x*, to revolve with great speed ; the velocity of the cutter being determined by the proportions which the diameters of the pulleys *g*, and *i*, bear to each other, and the speed of the driving power. The cutter *x*, being set to the depth of cut required, by adjusting the stop *v*, the workman presses down the treadle-rod *t*, with his foot, which causes the lever *w*, to raise the spindle *d*, with the cutter *x*, and the several parts attached thereto ; thus the forked arm *e*, is raised, and being moved around the cutter *x*, may be passed over the tablet *p*, in an arc ; at the same time the movable table *o*, must be turned, so that the cutter may be perpendicularly pendant over the part of the tablet where the work is to commence. The revolving cutter *x*, is then let down, by removing the pressure from the treadle-rod *t*, and it immediately penetrates into the tablet. The form in which the cutter moves over the tablet is now to be determined by guiding the shaft of the cutter against the edges of the template or pattern ; the table *o*, with the tablet *p*, upon it, being moved at the same time, in order to keep the edge of the template always close to the shaft of the cutter. By thus moving the swinging-frame *e*, and the table *o*, various arcs of circles, that are constantly tangential to each other, may be traced upon the tablet under operation ; thereby enabling every possible variety of regular and irregular, curved and straight forms to be cut or carved in the material acted upon ; and this combined or simultaneous action forms the principal novelty of the invention.

The patentee claims the combination and application of the several

parts, as herein shown and described, and any variation of that combination or application, for effecting the principle of his invention; provided the swinging-frame, which carries the cutter, and also the table on which the article to be wrought is placed, have both the means of circular motion.—[Enrolled May, 1844.] *London Jour. of Arts & Science.*

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*Specification of a Patent granted to EDWARD GUIGUES, of the county of Surrey, for improvements in Printing on Leather and Skins, being a communication.*—[Sealed 17th October, 1844.]

The improvements in printing on leather and skins, which constitute this invention, are as follow:—The patentee takes goat, sheep, or other hides, tanned, by preference, with Sicilian sumach, and washes them in water, to remove all oily matter, and any sumach that they may contain. For one dozen skins, a pint of sulphuric acid, of 66° Baumé, and 12 gallons of water, heated to 90° Fahr., are put into a tub, and in this liquid the skins are immersed for ten minutes; they are then immersed in the same quantity of cold water for a quarter of an hour, after which they are placed upon a table, and by the process of “striking out,” nearly all the water is extracted, and they are hung out to dry; when about half dry, the skins are laid, one above another, upon a table, and brushed smooth, in order that they may be more easily printed upon; and after remaining on the table for a day, they are ready for the printer.

The printing-table, and the accessories, are the same as when printing on stuffs and other fabrics; but the modes of preparing the colors are different. The following solution is mixed with all the colors, to render them unalterable and proof against acids:—Half a gallon of muriatic acid, of 81° Baumé, and a quarter of a gallon of aquafortis, of 36° Baumé, are introduced into a flat bottle with a long neck, termed a “matrass,” which bottle is placed upon an oven, heated to 100° Fahr., and gradually raised to 150°; then 1 lb. of sal-ammoniac is cut very fine, and, every two minutes, 1 oz. of it is put into the bottle, until all is dissolved; then 1 lb. of granulated tin is divided into twenty equal parts, and one part is introduced into the bottle every ten minutes. As soon as the tin is perfectly dissolved, the bottle is taken off the oven, and the solution allowed to “fine” during two days; at the expiration of which, it is poured into a bottle, and kept tightly corked.

The colors are prepared in the following manner:—For red, 4 lbs. of Brazil chips are put into 4 gallons of salt water, and boiled for six hours; then the liquor is passed through a sieve, and allowed to remain for a month before being used: to every pint of this liquid color, one-fourth of a pint of the solution, above described, is added. Violet is made by substituting Campeachy chips for the Brazil chips; the color is ready for use immediately after straining; and the solution is added in the same proportion as to the red. Yellow is produced by using Persian berries; and the color is ready for use when cool. Other colors are prepared in like manner.

After the skin has been printed, and is perfectly dry, it is dipped into cold water, and then into water heated to 100° Fahr., (to which

sulphuric acid has been added, in the proportion of 1 pint to 12 gallons of water;) when the skin has remained in the latter for three minutes, it is withdrawn, and soaked in cold water for ten minutes; it is then laid upon a table, and the water extracted by the process of "striking out;" after which, the surface is smoothed over by hand, with linseed oil, and the skin is hung up to dry; when dry, it may be polished in the ordinary manner.

The patentee claims "the mode of printing leather and skins, by the use of a preparation of the materials as herein described."—*Enrolled April, 1845.* Ibid.

## BIBLIOGRAPHICAL NOTICE.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*A Treatise on the Steam Engine, by the Artizan Club—to be completed in twenty-four monthly parts—illustrated by Steel Plates and Wood Cuts.* Published by LONGMAN, BROWN, GREEN & LONGMAN, London. *Price, 1 shilling per number.*

We have always thought that the history of the steam engine, from its first crude elements to its present elaborate and varied form, was the best means of illustrating its construction and principles, and have, therefore, much pleasure in noticing that such has been the course of the new periodical, entitled "*A Treatise on the Steam Engine*," by the Artizan Club, of which work we have received the first nine numbers.

In glancing over these numbers, it is evident, that a vast amount of useful information has been concentrated in a very small space, and that the matter has been collected in a systematic form.

A brief space has been devoted to the history, with descriptions and illustrations, of the structure of the early attempts, from which has grown to maturity, this all powerful agent, each step of which, is perspicuously described and exhibited. The work then proceeds to the discussion of principles, with useful illustrative tables; each number having a well engraved plate, of an engine, of modern construction, for mining, marine, or locomotive purposes.

The work then proceeds to the structure of furnaces, boilers, and to fuel, with smoke consuming arrangements, &c.; with numerous cuts, of a legible character, taken from authentic examples.

If this work is continued in the style in which the numbers before us have been conducted, of which we have no doubt, from the ability thus far displayed, it will furnish the mechanician with the means, in a collected form, of making himself thoroughly acquainted with the structure of the steam engine in all its phases, and will give him a plain and practical illustration of all its principles.

Our time will not admit, even if we were so disposed, to enter into a critical examination of the various tables and formula contained in these numbers, but we have no doubt that those who have the inclination and ability, will find both pleasure and profit in an examination of them; and we are sure that the mechanicians and engineers of

our country will derive much pleasure from the information contained, and promised, in the published and forthcoming numbers of this useful periodical.

## FRANKLIN INSTITUTE.

### *Costill's Cast Iron Screw and Nut, for Bedstead Fastenings.*

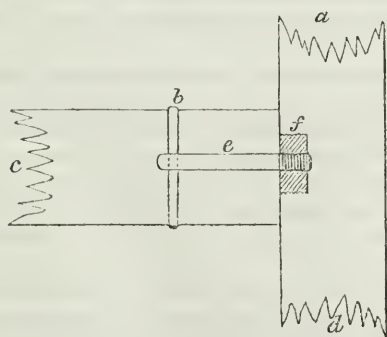
The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, to whom was referred for examination a Cast Iron Screw and Nut for Bedstead Fastenings, invented by Stacy Costill, of Philadelphia, Penna., REPORT:—

That hitherto, the swelled beam windlass bedsteads have had male screws formed on the ends of the wooden rails, right and left, so that by turning these rails by a simple wrench, the rails and posts could be successively brought into contact, so as to form the ordinary four-post bedstead.

This arrangement is liable to some objections, which would apparently be obviated by forming the male screw of iron, and inserting, also in the post, a nut of the same metal.

Precisely this object is attained by this contrivance of Stacy Costill, who casts, in suitable flasks, a male screw of *cast iron*, of about three-quarters of an inch in diameter, and four and a quarter inches total length; the thread of the screw being three-quarters of an inch in length, the remaining three and a half inches forming a cylindrical shank, which is inserted into the body of the rail, and is therein confined by an iron pin.

The female screw—*similarly cast*—is, in fact, a cylindrical nut, having both an *interior* and an *exterior* thread; the interior receives the screw before mentioned, which projects its length from the end of the rail; and by the exterior thread, this cylindrical nut is screwed into the post, being turned by a square bit, of which the corners catch into notches formed across the threads of the interior screw.



*a d*, post of bedstead.  
*c*, rail of bedstead.  
*b*, pin through shank.  
*e*, shank of screw.  
*f*, cylindrical nut.

The cheapness, strength and permanence of this kind of fastening, and the ease with which it admits of adjustment, by propelling or withdrawing the cylindrical nut, with the square bit, recommend

this arrangement to the notice of cabinet makers, and induce us to give it our approbation.

We must, however, recommend, that a wrench with a square end, adapted to the management of this contrivance, should in all cases be furnished by the maker, with bedsteads so constructed.

By order of the Committee,

WM. HAMILTON, Actuary.

*Philadelphia, January 9th, 1845.*

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*Savery & Co.'s Enameled Cast Iron Ware.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination specimens of Enameled Cast Iron Ware, manufactured by Messrs. Savery & Co., of Philadelphia, Penna., REPORT:—

That, they have examined the ware, both by inspection and by mechanical and chemical experiment. The two articles more minutely examined were a griddle, or baking-iron, and a small pot for boiling liquids. The mixture composing the enamel consists, probably, of silex, clay, flint glass and borax; and the two articles seem to have been differently coated, for they withstand chemical and mechanical action differently. The enamel on the griddle is superior to that of the pot, and was severely tested, by placing it directly on a hot fire and throwing water on it, which had no effect in loosening or cracking the enamel. On breaking the enamel, subsequently, with a hammer, but a small particle was removed at each blow, and even after the subjacent surface of iron had been exposed, the hammer still continued to remove only small fragments. The enamel, therefore, possesses considerable toughness, is very hard, and adheres with great firmness to the surface of the metal. Nor could openings or pores be detected in it which extended to the metal, and might loosen the adhesion after continued use and cause the enamel to scale off. The surface of this enamel was as smooth as is desirable for the purposes for which it is designed, and it possessed a sufficient degree of whiteness.

The glazing of the pot was more rough on the surface, less white, covered with numerous small black specks, or spots, and a number of small holes or pores were detected, into which a pin might be thrust to the subjacent iron. Muriatic acid heated in the pot for 15 minutes dissolved but little iron, although when nitric was added to it, a large proportion of iron was dissolved, in the cold, in 24 hours. A portion of the iron dissolved was, probably, due to the black specks above mentioned, for after removing the acid, the surface was much more free from them, but a portion was also due to iron dissolved out through the small pores. For by putting the acid in one part, where a single pore was observed, and letting it remain for a few days, the glazing scaled off readily around the pore. It should be observed, that the glazing could be picked off piece-wise, by a knife, when the pot was first examined, previous to the chemical tests.

Additional experiments, with a larger enameled iron pot, proved its glazing to be of fair quality, having the desirable physical qualities of hardness, toughness and whiteness, and offering sufficient resistance to acids. It still presented the defect of pores, observable in the smaller pot.

In the opinion of the Committee, if the griddle alone should be considered as an example of the ware, it is of superior quality, being white, smooth, hard, tough, adhering with great force to the iron, and presenting great resistance to chemical agents. If the smaller pot be the standard, the ware is not perfected. If we draw conclusions from both specimens, it is that the manufacturers are capable of producing an article of the best quality, but that the products of their manufacture are not always uniform. If the ware could always be made of the same quality with the griddle, it would deserve high commendation.

The presence of flint-glass in the composition is decidedly objectionable, for its content of oxide of lead will be a constant cause of a darkening or blackening of the surface when some liquids are introduced into an enameled vessel and heated in it. It will, therefore, be the manufacturer's interest to substitute a leadless glass for flint-glass, which is successfully done in England and on the continent of Europe. But the presence of lead is objectionable on a higher ground, viz: its injurious effects when introduced into food, which may readily take place, especially where much alkaline matter is present in the enamel. Now, although a small quantity of lead in the glazing might not be injurious, yet it would be easy to introduce a larger quantity; a temptation to which the manufacturer is exposed from its greater economy and fluxing power. It is therefore advisable to reject its use altogether.

The use of borax presents the advantage of cleansing the surface of iron more or less during the fusion of the glaze, and causes the whole body of the glazing to adhere more firmly to the metal; but the previous cleansing of the surface of metal by acid or acid salts should not be dispensed with.

By a careful selection of pure quartz and kaolin, which may be termed the body of the glaze, and by a careful fusion of the materials, the glaze may be obtained perfectly white, and free from the black spots alluded to in the above ware.

Lastly, by the successive applications of a finely powdered glaze, that is, by two successive fusions, its surface will be rendered more smooth and beautiful in appearance, and less liable to the formation of pores.

By order of the Committee,

WM. HAMILTON, Actuary.

*Philadelphia, April 10th, 1845.*

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*A Mode of Tanning Leather by means of a Flagellator.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a mode of Tanning Leather by means of a Flagellator, patented in June, 1844, by Robert Downey, New Albany, Floyd County, Indiana, REPORT:—

That the object of the invention is to diminish the length of time

required in tanning, an object which has been kept in view of tanners during the last half century of general improvement in the arts, as witnessed by the almost numberless patents issued in various parts of Europe and the United States, during the time specified. These attempts have been successful to a very limited extent, since the general experience has been that in proportion as the time is diminished, the quality of the tanned leather is injured, or, up to a certain point, the quality is inversely as the time employed in tanning. Nevertheless, at the present time, it would be wrong to assert that a more rapid process, compatible with quality, cannot be devised.

Mr. Downey proposes *flagellation*, as the means of diminishing the time, on the assumed principle that the pores of the hide are closed in the ordinary tanning process, preventing thereby the entrance of the bark liquor. By flagellation with a machine, he believes that the hide is raised and thickened, the pores opened, and while the gelatin and gluten are oozing out, the bark liquor is driven in.

Without farther noticing the mistake in confounding gelatin and gluten, we observe two principles assumed; 1, "the closing of the pores by bark or its infusion;" 2, "the oozing out of gelatin."

1. The committee cannot agree with the proposition that the pores of the hide are closed, certainly not closed in such a manner as to prevent the solution of tannin from entering into them, and they confidently believe that all experience shows that the pores are open and remain so; for the length of time required in the ordinary process cannot possibly be ascribed to the extreme slowness of infiltration through closed pores. Where hides are suffered to remain too long in the *handler*, or on a *layer*, especially during the warm season, without renewing the supply of fresh bark, a species of fermentation produces a mucilaginous or slimy coating, which closes the pores more or less effectually, and this may be viewed as the only case in which a closing of the pores takes place.

2. The "oozing out of gelatin" is erroneous; for the practical tanner knows of no case of the loss of gelatin by mechanical means, and it may be shown to be impossible on chemical grounds. The gelatin does not exist ready formed in the hide, but by the action of hot water the tissues are transformed into gelatin, and the same takes place slowly during the operation of tanning, lapse of time with the conjoint action of tannin in solution performing the transformation which heat effects rapidly. But, on the other hand, admitting the proposition to be true that flagellation presses out gelatin, the tanner can show that it would be positively injurious; for the leather would not exhibit that increase in weight which it is his aim to produce, not merely for the increased profits due to the greater number of pounds, but because this increase in weight increases the firmness and durability of the leather. Gelatin combines with a certain proportional quantity of tannin constituting leather; hence, when a portion of the former is lost, there is nothing to replace it, for the remaining gelatin will only take up its due proportion of tannin and no more, and all other matter added to restore the lost weight would be mechanically

intermingled or lodged in the leather, while nothing can compensate for the loss of firmness and durability.

The committee would state that no samples of leather having been offered them prepared by Downey's process, they have judged of the value of the process on general principles

By order of the Committee,

WM. HAMILTON, Actuary.

*Philadelphia, April 10th, 1845.*

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## MECHANICS, PHYSICS, AND CHEMISTRY.

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*The Progress and Present State of the Daguerreotype Art.* By  
M. CLAUDET.

The discovery of a new art founded upon some startling facts in science, however perfect it may appear at the beginning, and little subject to improvement, rarely remains long stationary; and still more rarely can we foresee all its useful applications.

As this observation applies particularly to the ingenious and curious discovery of Daguerre, it may be interesting at the present moment to examine the progress it has made during the last four years, and to determine its present state, in order that we may be able to compare, at given periods, the various stages of improvement through which photography has passed.

The daguerreotype has opened two extensive fields of inquiry: the one, for the investigation of facts, by which the sciences are to enrich themselves, and by which some of the phenomena of the laws of nature may be explained; the other, for the advantage of society, in reference to the creation of a new branch of manufacture, and to a new art, which are destined to give employment to many persons; to which may be added the improvements that the daguerreotype will introduce in the fine arts.

It has been remarked that the discovery of photography was as great a step in the fine arts as that of the steam engine in the mechanical arts. There is no exaggeration in this observation; and certainly our age (which is the era, not of wars and conquests, but of social improvements, of emulation in the arts, sciences, and manufactures,) will be celebrated in future times for this extraordinary invention.

It is curious to observe how rapidly sometimes new discoveries are followed by other important discoveries, forming the links of a mysterious and infinite chain, one end of which approaches the great Creator of all things.

In the year 1811, Courtois discovered the chemical substance called Iodine, and, as late as 1826, Balard discovered Bromine; these two elements are the only substances which, in the daguerreotype, form with the silver a compound sufficiently sensitive to the rays of light, and without which substances the daguerreotype could not have existed.

Such is the progress of science, that there is no fact, however insignificant it may appear at first, which does not aid the advancement of philosophy, and the improvement of mankind.

When these new elements were first discovered, how little was it thought that they would so soon become the source of the magic invention of the daguerreotype, which again will undoubtedly lead to other discoveries, perhaps far more important than itself!

There are some persons who, although admiring the daguerreotype in its effects, perceive nothing beyond the mere spontaneous, although beautiful reproduction of objects—the representation of a building or a landscape in their minutest detail, and in the portraying of human features: but this is only the useful and immediate application of the art in its state of infancy; its destinies are of a much higher order.

It may be said that already optical science has been much benefited by it. Never before has it been found so necessary to construct object glasses with the shortest possible focus, without increasing their aberration; this has now been done, and we have double achromatic object-glasses refracting a perfectly well-defined image upon a screen of seven inches in diameter, although the focal length is not more than eight or nine inches: this improvement in the object-glasses of the camera obscura, being also applicable to the construction of telescopes, will enable opticians to make powerful instruments of a considerably smaller bulk.

The science of optics, the study of which was confided almost exclusively to professional opticians and astronomers, is now in the hands of a thousand operators in photography, who are constantly studying and endeavouring to correct the imperfections of their apparatus; and their researches and investigations will, no doubt, ultimately lead to many useful discoveries.

In passing from the practical part of optics to that which is purely theoretical, that which treats of the various rays emanating from the sun, of their laws and properties, and of the principles and phenomena of light, considered as a whole, or a compound of various kinds of matter (if I may be allowed the expression,) as being produced by emission or by undulation; if these interesting points are ever better explained and understood than they are at present, it appears highly probable that the daguerreotype will be the instrument leading to these results: at least it is certain that, in experiments and researches upon this subject, philosophers will be greatly assisted by the innumerable facts collected in the daguerreotype operation.

The existence of invisible or chemical rays is proved by the various processes of photography; for in speaking of the daguerreotype, we cannot omit to mention the beautiful discovery of Mr. Talbot, which he has called the Calotype. Neither must we omit the curious discoveries of Sir John Herschel, forming another step in photography, which is called by that learned astronomer Cryotype.

The experiments made in these various photographic processes all agree in the fact, that the rays which produce a change upon the sensitive screen are not the rays of light, but other rays traveling with light, and emanating from the same source, which are sometimes more

refrangible than the violet rays, and less refrangible than the red rays under other circumstances; by which it would appear that there exist chemical rays on each extremity of the spectrum: but many facts seem to prove that there is also another kind of ray which is refracted to all parts of the spectrum according to the dispersive power of the lens, and following certain laws of refraction which are different to the laws regulating the other rays; so that different kinds of glasses may have the same power of dispersion for the apparent rays, and be endowed with different dispersive powers for the invisible photographic rays.

I am not prepared to develop the facts by which I have aimed at this conclusion, because my experiments are not yet complete enough to furnish a sufficiently plausible and satisfactory explanation of this phenomenon.

From the application of the daguerreotype to the advancement of practical and theoretical optical science, let us consider how this art is likely to benefit chemistry.

In this respect, is it not sufficient to call to mind that some of the elements we have alluded to, viz. iodine and bromine, have been very little investigated by chemists, and that all their properties are not yet known, neither have the whole of their compounds been ascertained?

Now that they are so much employed by every photographer, and their effects minutely studied, is it not reasonable to expect that in the hands of the chemist, also, the daguerreotype may become the medium of scientific research?

After having enumerated the advantages which several branches of science have already derived from the daguerreotype, and having hinted at those which they are still likely to derive from new investigations arising out of the same subject, we shall now refer to its connexion with the fine arts.

There is a singular anomaly in the history of the progress of human discoveries. They frequently seem to follow each other in an inverted order, and very often the ingenuity and perseverance of man, through immense labour and research, have produced works which previously existed in nature, and which, had nature been first studied, would have been executed in much greater perfection, with the saving of an immensity of trouble.

After ages of civilization, it is only within the last two centuries that Battista Porta, being in a dark room, observed that an inverted image of outwards objects was represented on the wall, opposite to a small hole in the window-shutter; to the hole he applied a convex lens, and then, instead of a diffused and indistinct image, he was able to obtain a well-defined and clear picture.

This accidental discovery was the origin of the camera obscura. Yet in nature such instruments have existed since the creation of man, for the eye is nothing more than a perfect camera obscura.

If philosophers had only turned their attention to the construction of the human eye, if they had been able to examine its beautiful arrangements, the camera obscura would have been discovered at a much earlier period. The same observation applies to the discovery

of galvanic electricity, and the apparatus by which this principle is developed. There exists in nature the most perfect and complete galvanic battery; and if philosophers had been able to examine the *Gymnotus electricus*, or electrical eel, it would not have been left to chance and ingenuity to discover one of the most splendid phenomena in the circle of science.

In all cases we find, that whatever we at first consider as a new invention existed before in nature: therefore, man invents nothing, he merely discovers that which has long before been produced by the hand of the Creator; and, as Bacon asserts, "man is only the interpreter of nature."

By the judicious combination of black lines or black dots upon white paper, or white lines and white dots upon black paper, artists have been able to represent all objects visible to the eye; the effect is complete and identical.

The laws of perspective are well understood by this simple means.

We thought that such a work was quite artificial, a calculated imitation of nature which was not true, but that we learned, as it were, to read by habit. We thought that a child could no more understand a picture than read a book. But here again art has been invented, and it is only lately that we have found that nature operated exactly as art, and produced the very same effects.

The daguerreotype represents the objects which we see by the same rules, by the very same means, and proves that the objects cannot be represented otherwise than as the painters had represented them before.

If the daguerreotype had been invented before the art of painting, then we should have never doubted its accuracy, and we should not have thought that we were deceived or taken by delusion.

The daguerreotype plate is etched in by nature, exactly (although in a more perfect manner,) as is the plate of copper or of steel by the ingenuity of the engraver.

When we submit a daguerreotype plate to the magnifying power of the microscope, we observe upon its surface an infinite number of small white dots, which are more or less close to each other, according to the predominance of light or shadow in the picture. In fact, the magnified surface of the plate has the appearance of the sky on a bright night; the white parts present an agglomeration of bright dots, similar to the milky way seen through a telescope, which to the eye appears as a white drapery or belt thrown across the sky.

It would not, therefore, have been surprising if the arts of drawing and painting had been the consequence of the daguerreotype; but it is really wonderful that, without the help and the labours of the daguerrean process, drawing and painting should have attained the perfection so conspicuous in the works of the great masters. Indeed that single fact proves, more than any thing else, the greatness of their genius.

However, it was only given to a very few to grasp nature, but henceforward young artists, of less genius, will be able, by studying the effects of the daguerreotype, to produce works of great merit.

We may also assert that the great masters would have been still more perfect in their imitations of nature if the daguerreotype had been known to them. When Paul Delaroche, the celebrated painter, was asked his opinion of the invention of Daguerre, he unhesitatingly declared that "the process of M. Daguerre had given to art many conditions so essential to its perfection, that they would become, even to the most skilful artists, subjects of observation and study;" and, further, that "this admirable discovery was an immense service rendered to the fine arts."

Is it, then, surprising that the announcement of the discovery of Daguerre created among philosophers and enlightened men so great an interest? that it was received with such amazement and admiration? Is it surprising that the government of a great nation should have proposed to its parliament to award to the discoverer a national recompense?

Two centuries ago the daguerreotype art would have been looked upon as the work of witchcraft, but in our age of improvement we are accustomed to extraordinary discoveries; we are capable of admiring and appreciating these huge efforts of genius, and nothing surprises us. The steam-engine, that perfect machine, so well organized (which, as an animal, requires only to be fed to work by itself, and to produce continuous motion,) has been created almost in our own time and under our own observation.

After such a triumph of the genius of man and of modern science, we see no limit to human discovery; and, indeed, we might believe, that the word *impossible* should be erased from language.

The year 1839 gave birth to two discoveries, which, from the similarity of their properties and results, may, with propriety, be called sister arts. These are the daguerreotype and the electrotype, both of which re-produce and multiply in the greatest perfection; the one acting under the influence of light, the other under the influence of electricity; these two mysterious agents seem, in fact, to constitute the soul of nature.

In the case of the daguerreotype light draws—in that of the electrotype electricity models; and although their work seems, at first sight, to have no connexion, still the two act in unison. The daguerreotype image may be repeated to any extent by precipitating metal upon it by the action of electricity, producing another plate upon which the original is imprinted in its various tints; in fact, the two images are so identical in their effect, that it would be impossible, without knowing previously of what metal they were respectively composed, to decide which was the original and which the copy. This curious phenomenon may assist in explaining the nature of the formation of the daguerreotype image; it proves, undoubtedly, that the light and mercury acting together upon the iodide of silver, alters the arrangement of the molecules of the surface so that minute crystals are produced, which, like cut diamonds, present in almost every direction a favorable angle of reflection to the eye, from which cause they assume a white appearance; the electrotype surface, moulded upon these crystals, receives exactly their counterpart,

and the two surfaces are to each other as the relief is to the matrix which has produced it; so that parallel faces having the same angle of reflection for the eye, corresponding parts of the image present identically the same effect; and this curious reproduction of the electrotpe illustrates better than any other effect the great perfection of these metallic deposits, and also the infinite minuteness of the particles of metal reduced by the galvanic agency.

The original process of Daguerre consisted in submitting a polished plate of silver to the vapor of iodine, until by the chemical combination of the two a compound was found exquisitely sensitive to the influence of light, so that when the image at the focus of a camera obscura was thrown upon a plate thus prepared, the design was invisible, though certainly impressed; and this latent image was afterwards brought out by the action of the vapor of mercury. This was his process in all its simplicity; and it seemed at first to be but little susceptible of improvement; in fact there appeared to be scarcely any room for alteration, at least to advantage. Nevertheless, the manipulation recommended by Daguerre has been greatly simplified, and rendered more effective; although, strictly speaking, the invention has remained the same, the changes consisting chiefly in modifications of the original operations.

It is always a surface of silver, coated with iodine, exposed to the influence of light in the camera obscura, and then submitted to the vapor of mercury for the purpose of bringing out the image, after which it is immersed in a solution of hyposulphate of soda, to remove by solution all traces of the iodine from its surface. Up to the present time it has never been found possible to alter, materially, any of these fundamental principles.

The improvements introduced have been chiefly in the instruments employed, and in some additions to the chemical parts of the operation; by the first means greater artistic effect has been given to these pictures, they have been rendered more forcible and defined in detail; and, by the last-named improvement, the plates have been made much more sensitive to light, so that the time of the operation has been amazingly diminished. With the original process it was considered impossible to apply the daguerreotype to the production of portraits; for, with the iodine alone, and the long-focused camera obscura which was at first employed, no picture could be taken, even under favorable circumstances in less than about a quarter of an hour; and as the correctness of a portrait produced by this art depends upon perfect immobility during the whole of the sitting, the mere idea of such an application of photography was looked upon as altogether absurd.

But the fact that an image could be obtained in a quarter of an hour, gave the hope that, by improving either the optical arrangements of the camera, or the chemical preparation of the plate, means could be devised to arrive at the grand desideratum, viz. the application of the daguerreotype to portraiture.

It was, however, soon found that, by constructing object-glasses having a shorter focus, the operation could be reduced nearly in proportion to the reduction of the length of the focus, so that, by applying

to the camera an object-glass of three inches focus instead of twelve, the operation was four times shorter, or reduced to about four minutes.

From that moment portraits were taken by the daguerreotype; but still few persons could remain in perfect quiescence during such a length of time, and if they were able to do so, it was only by submitting themselves to a painful constraint, which unavoidably gave to the countenance a most unpleasant expression. Nevertheless this was a step which encouraged the idea of further improvements; and about this time an ingenious optician of New York, Mr. Wolcott, thought of substituting for the refracting glasses a concave mirror, of such an aperture, that a greater amount of light from the object might be concentrated at its focus, where he placed the sensitive plate. By this means he could operate much more quickly than by a refracting apparatus, and thus reduce the time of sitting.

This was another interesting step in the improvement of the art, but such a process was subject to many difficulties and defects, which rendered it inferior to the refracting apparatus. If the mirror was made of metal, it was subject to corrosion, by being constantly exposed to the changes of the atmosphere; if it was of glass, then two images of different focus were formed, the one from the silvered surface, and the other from the surface of the glass, so that a sharp and well-defined image could not be produced. Another material defect, however, of this process was that by necessity, in placing the plate between the object and the mirror it was absolutely necessary to operate upon a very small size, or else the plate would have screened the greater part of the aperture, and the advantage of the increased reflecting area would be lost. Besides, the rays producing the best definition and the most correct image, are reflected from the centre of the mirror, and are precisely those which are lost by the unavoidable position of the plate.

To be Continued.

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*On the Anthracite and Bituminous Coal Fields in China; the System of Mining, and the Prices of Coal, and Labour in its Production, and Transportation to Peking.* By RICHARD C. TAYLOR, Philadelphia.

We have seen the recent announcement of the sailing, from hence, of a vessel containing 308 tons of Pennsylvania anthracite, destined for Hong-Kong, in China. Some very natural speculations have arisen from this circumstance, as to the probability of that country furnishing a market for American anthracite. As no details accompany the statement alluded to, we are not in possession of any material facts whereby an estimate can be formed of the probable success of the undertaking, in a commercial sense; and we are not sure but the coal may have been employed for convenience merely, as ballast.

In the East Indies various depots of European coal have been established, for the service of the British government steamers. This fuel, for the most part, it is understood, consists of the anthracitous

and partially bituminous coals of South Wales, of course obtained at great expense. It appears that 5000 tons of English coal, at a freightage of about £2 per ton, are annually imported into Bombay, for the Company's steamers. Bituminous coals have been derived from much less distant sources; among which the Burdwan coal field, in the vicinity of Calcutta, may be named. Mergui Island, also, in the Bay of Bengal, has lately furnished some steam coal to Singapore. The steam ships on the China seas, during the war with that vast country, were supplied from these various sources.

I do not propose to discuss the profitableness, or otherwise, of a Chinese market for our American anthracite. But as during the process of collecting statistical information for a proposed volume on "the geological and geographical distribution of coal and other mineral combustibles," some notes reached me, of an interesting character, which are not generally accessible to the majority of readers, with relation to the Chinese coal fields, it has struck me that a portion of these details, in an abridged form, might be just now acceptable, particularly as the intercourse with that country is on the increase. I venture even to omit, for the present, the authorities for the facts I shall have to communicate; reserving them in detail for the volume adverted to. It must, nevertheless, be premised that to the Jesuit Fathers, the French Missionaries who were permitted to reside at Peking during the 18th and preceding centuries, we are indebted for details of the highest interest, not alone on this subject, but on many other objects of philosophical inquiry in that little-known region.

It is probable that coal was discovered, and was in common use in China, long before it was known in the western world. It is mentioned by a noble traveler of the 13th century, as abounding throughout the whole province of "Cathay," of which Peking is the Capital, "where certain black stones are dug out of the mountains, which stones burn when kindled, and keep alive for a long time, and are used by many persons, notwithstanding the abundance of wood."

The good missionaries were fully capable of describing the coals which were supplied to Peking, since they there erected a furnace or stove, in which they experimented on the properties of those combustibles; particularly with reference to the ordinary domestic uses, and for the warming of apartments and the purposes of their laboratory.

Among the people of Peking, three kinds are in use.

1. That employed by the blacksmiths. It yields more flame than the other qualities; is more fierce, but is subject to decrepitate in the fire; on which account, probably, the blacksmiths use it pounded in minute particles.

2. A harder and stronger coal used for culinary purposes, giving out more flame than the other sorts so employed; it is less quickly consumed, and leaves a residuum of gray ashes. There are several gradations of these. The best are hard to break, of a fine grain, a deep black color, soiling the hands less than the others. It sometimes is sufficiently siliceous to give fire with steel. Others have a very coarse grain, are easily broken, and make a bright fire, leaving a reddish ash. Another species crackles, or decrepitates, when first placed

on the fire; and falls down, almost entirely, in scales, which close the passage of the air, and stifle the fire.

3. A soft, feebly burning coal, giving out less heat than the 2nd class; consuming more quickly, it breaks with greater facility, and in general is of deeper black than the sorts previously mentioned. It is commonly this description, which, being mixed with coal dust and a fourth part of clay, is employed to form an artificial and economical fuel. This being moulded in the form of bricks and balls are sold in the shops of Pekin. Wagon loads of coal dust are brought to that city for this sole purpose.

The coal merchants have also an intermediate quality, between the classes 2 and 3.

We cannot, in this place, recite the numerous details which are furnished by these intelligent Fathers. Suffice it to add, that nearly the whole of the properties and applications are now in every day use in the United States, and are familiar to all. They are, in fact, the natural results suggested by qualities possessed in common by the combustibles of remote parts of the same globe. Even the modern method of warming all the apartments of our dwellings, which we view as the result of superior practical and scientific investigation, was in use with very little deviation, centuries ago, by the Chinese. Many a patented artificial fuel compound both in Europe and America, has been in practical operation in China, at least a thousand years.

4. ANTHRACITE. Another description of coal abounding about thirty leagues from Pekin, but which was not then in such general use there as the other kinds, is called by the Chinese Che-tan. Che means a stone, but tan is the name they give to wood charcoal. Therefore, according to the genius of the Chinese language, this compound word signifies a substance resembling or having the common properties of stone and charcoal. There can be little difficulty here, in recognising the variety of coal which, in our day, has been denominated anthracite, a compound word of similar meaning.

The Chinese *glance coal* forms a remarkable exception to the unfavourable conclusion prevailing against Oriental coal; and, according to more recent authority than those we before cited, deserves to rank at the head of the list, in respect of its purity as a coke; although, in specific gravity, it does not come up to the character of the Pennsylvania or Welsh fuel; neither has it the spongy texture which contributes much to the glowing combustion of the latter.

So late as 1840, a Russian officer has described the coal formations of the interior, as occupying the western mountain range of China, in such abundance that a space of half a league cannot be traversed without meeting with rich strata. The art of mining is yet in its infancy among the Chinese; notwithstanding which, coal is thought to be at a moderate price in the capital. Anthracite occurs in the western range of mountains at about a day's journey, or about thirty miles, only from Pekin. The coal formation is largely developed, in which thick beds of coal occur. They appear to be of various qualities. Some of this coal, occurring in shale beds, is singularly decomposed, and its particles have so little cohesion, that they are almost reduced

to a state of powder. Beneath these coal shales are beds of ferruginous sand stone, and below those occur another series, consisting of much richer seams of coal than the upper group.

In this range are seen also both horizontal and vertical beds of conglomerate, accompanied by seams of coal, which have the conglomerate for the roof, and diorite or greenstone for the floor. As might be expected, this coal very much resembles anthracite. It is shining, of compact texture, difficult to ignite, does not flame in burning, or give out any smoke. Its substance is entirely homogeneous. Every thing respecting it, leads to the belief that there had been a great development of heat at the period of its formation, or subsequently. The horizontal coal beds are the most important and valuable, and are denominated large; but no greater thickness than three and a half feet is quoted. The blacksmiths and those who work in copper, prefer this coal, on account of the intense heat which it gives out.

Throughout the whole of this mountain range may be continually seen the outcrops of this combustible, where they have never, as yet, been touched by the hand of man.

In those parts of China where wood is very dear, coal is worked on a great scale for the Pekin market; but the process of mining is very little understood by those people, who excel in the preparation of charcoal.

*Coal in other parts of China.*—The Missionaries and others inform us that coal is so abundant in every province of China that there is, perhaps, no country of the world in which it is so common. The quays at Nankin are stored with the finest native coal. Some of the coal which was brought down to the coast, from the Pekin country, to the Gulf of Pe-tchee-lee, was anthracite, partaking of the character of plumbago or graphite. Coal, apparently of the brown coal species, exists extensively in the direction of Canton; while all the coals seen on the Yang-tse-kiang river, south of Nankin, resembled cannel coal. Nearer to Canton it possessed the comparatively modern character of brown coal. It was abundantly offered for sale in the different cities through which Lord Amherst's embassy passed, between Lake Po-yang-how and Canton, and the boats were largely supplied with it. It is there obtained by means of pits, like wells; and we infer that, like nearly all the brown coal deposits, the beds were horizontal, and at no great depth. A sulphurous coal, interstratified with slate, and in the vicinity of red sandstone, also prevails towards Canton.

Thus, therefore, we possess evidence, the main object which this communication was designed to exhibit, that extending over large areas in China, are beds of tertiary or brown coal, of cannel coal, a dozen varieties of bituminous coal, of anthracite, glance coal, and graphitic anthracite; all of which, for ages, have been in common use in this remarkable country; and have been there employed for every domestic purpose known to civilized nations of all times; including gas lighting, and the manufacture of iron, copper, and other metals.

*Mode of Mining Coal in China.*—It might be expected that in China, where most of the practical arts have, from time immemorial,

been carried on with all the perseverance of that industrious people, the operations of mining coal would be conducted with some regard to science, in relation to sinking, draining, and extraction. We have, however, good authority, especially in regard to the environs of Peking, for stating that the process is still in a very imperfect state. Machinery there to lighten labor is unknown. They have not even an idea of the pumps indispensable to draw off the water. If local circumstances allow, they cut drainage galleries; if not, they abandon the work whenever the inundation has gained too far upon them. The mattock and shovel, the pick and the hammer, are the mining instruments—the only ones, in fact, which the Chinese employ in working the coal. The water of the mine is emptied by the slow process of filling small casks, which are brought up to the surface by manual labor. Vertical shafts are not used. In working horizontal coal seams, the timbering is expensive, and the materials cost about 2 copecs per pound, = \$8 50 per ton, English wood being sold by weight in China.

The coal, when mined, is put into baskets, and drawn upon sledges, which are raised to the surface by manual strength. Each basket contains about three pounds of coal, and one man can raise about eight baskets in a day. This is equivalent to 1032 Russian pounds, or to 12 cwt. English, per day. The miners' wages are at the rate of 30 copecs a basket; which is equal to 240 copecs [copper currency,] or 46 cents of United States currency, per day; being \$0 76 U. S., per ton.

*Prices at Peking.*—At the pit's mouth, this coal is sold for 60 copecs per pound, = \$4 63 per ton of 20 cwt. It is then conveyed on the backs of mules through the mountains, and thence on camels to Peking, where the price is  $1\frac{1}{2}$  rouble, =  $1\frac{1}{2}$  francs, = 29 cents United States, per pound; which, if our calculation be correct, is equal to \$11 60 United States, or £2 8s. 3d. per ton of 2240 pounds English. We perceive, therefore, that the best of fuel is expensive at Peking, and hence the necessity for resorting to the artificial compounds and substitutes to which we briefly alluded.

There is, however, a kind of coal sold in that city at a much lower price, particularly when it is mixed with one-half of coal dust. This coal, in 1840, sold for one rouble per pound, which is at the rate of \$7 75 = £1 12s. 3d. per ton. It is of indifferent quality, however; giving out but little heat, and is quickly consumed.

The compound fuel, consisting of coal dust and clay, is still prepared after the mode described by the missionaries last century; but its use is chiefly confined to the indigent classes.

*Coal Gas Lighting in China.*—Whether, or to what extent, the Chinese artificially produce illuminating gas from bituminous coal, we are uncertain. But it is a fact that spontaneous jets of gas, derived from boring into coal beds, have for centuries been burning, and turned to that and other economical purposes. If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers, on a large scale; and have evidently been so, ages before the knowledge of its application was acquired by Europeans. Beds of coal are fre-

quently pierced by the borers for salt water; and the inflammable gas is forced up in jets, twenty or thirty feet in height. From these fountains the vapor has been conveyed to the salt works in pipes, and there used for the boiling and evaporation of the salt: other tubes convey the gas intended for lighting the streets and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the saltworks, and there forms separate chimneys or columns of flame.

One cannot but be struck with the singular counterpart to this employment of natural gas, which may be daily witnessed in the Valley of the Kanawha, in Virginia. The geological origin; the means of supply; the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are remarkably alike, at such distant points as China and the United States. Those who have read, even within the present month, the account of the recent extraordinary additional supply of gas, and the services it is made to perform at the Kanawha saltworks, must be impressed with the coincidence of all the circumstances with those which are very briefly stated in the previous paragraph, in relation to China. In fact, the parallel is complete.

To the coals and combustible minerals of China, I cannot further advert here. But what a conviction irresistibly presses upon the mind, as to the incalculable utility of the *Railroad system*, and coal mining improvements in such an empire! If ever there were concentrated at one point all the circumstances especially and unequivocally favorable to that system, and imperiously calling for improvements of the character suggested, it seems to be presented in the case of the city of Pekin. Here, with its enormous population of 1,500,000 souls, it is situated only at a day's journey—computed at thirty miles—from an immense region of coal, comprising several varieties. Yet its inhabitants cannot purchase the best qualities of this coal, brought from the mountains on the backs of mules and camels, under \$11 60 per ton, and the very worst for less than \$7 75 per ton.

Without making unnecessary or invidious comparisons, it might not unreasonably be suggested, that a Pekin railroad, in connexion with the coal mines, would be a far more profitable enterprise in its results, than the transportation of American coals to China.

I will only add one circumstance, which had nearly escaped me. Borneo, "the largest island in the world," which is only twenty degrees due south of Canton, has lately come into repute for the great quantity of coal which it contains, not only accessible to ships along the coast, but extensively occurring in the mountains of the interior. Much information has also been acquired from the natives; and the facts which are already elicited are regarded as of considerable importance, in respect to the facilitating the steam navigation of the China seas.

Philadelphia will, of course, have her share in the enlarged commercial intercourse with China. Would it, then, be asking too much of those who are personally interested in this improving trade, to com-

municate any additional facts, which are either unknown to, or have been omitted by, the author of these scanty notes?

*Philadelphia, April 28th, 1845.*

[NOTE.—The prices and admeasurements, which are quoted in the foregoing article, were reduced to the United States and English currencies and measures, from the Russian, as furnished by the Engineer Kovanko; who, in like manner, converted them into the Russian from the Chinese standards. In consequence of this triple conversion of standards, additional care has been taken to avoid error in these calculations.]

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*Description of an Artificial Hand.* By SIR GEORGE CAYLEY, BART.

Sir,—About eight years ago, George Douseland, a son of a tenant of mine, had the misfortune to lose his right hand, when I proposed to make him an artificial one, in the hope of rendering his loss rather less severe. The greater portion of this instrument was made, and the whole of it planned, at that time; but the stump was found to be so tender that it could not then be made use of, if completed; and the young man having gone to reside elsewhere, the thing was lost sight of, and was not renewed till about two months ago, when the remaining portion was executed; and he has found it of considerable use to him in his various daily occupations. I send you a sketch and description of this instrument, which is so simple as scarcely to deserve the name of an invention, but trusting that it may be found as useful to others under a similar misfortune, I wish to give it to the mechanical public through your valuable pages.

The instrument can be executed in many ways, though the means of deriving its firm and forcible grasp from the stump must remain much the same in all. Flexible tendons were adopted in the first sketch I made of this instrument, but I shall describe that which is now in use, and subsequently some very essential improvements; and I hope by thus publishing it, to prevent its being pirated and *patented*, as it is quite misfortune enough to lose a hand without being obliged to forego the use of even so humble a substitute, for want of means to purchase it, or otherwise to procure it at an exorbitant price.

I am, sir,

Your obliged and obedient servant,

*March 5, 1845.*

GEORGE CAYLEY.

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*Method of making an Artificial Hand, that will forcibly grasp substances of various sizes, and release them at will, so as considerably to supply the place of the natural hand, when that member is lost.*

The movements of this instrument, are derived from the stump, by fixing the hand to the upper portion of the arm above the elbow joint, by light frame-work, within which the stump has its movements at full liberty; and by placing a shank or lever, connected with the ma-

chinery of the hand, to the termination of the stump, it is put into forcible and efficient use.

Fig. 1

This will be more clearly understood by inspecting the sketch fig. 1, where A A represent metallic half hoops, riveted to the thin steel bars B B, and padded on the inside. When the arm is placed in these semi-hoops, it is secured there by the straps and buckles C C. The end of the stump is at the same time inserted into the padded hoop D, riveted on to the bars E E, which turn freely on the joints F F.

The hand, fig. 2, is fixed to a hoop G, which fits freely into the hoop H, fig 1, at the termination of the arm bars K K, and can turn within it, but cannot escape from it, by means of three small screws working in a groove.

The joints F F, are common to all these bars; but the bars K K can be fixed in any required position by a sliding spring bolt, working into teeth or holes in a circular part of the upper bar B; hence, the horizontal pin, M, is made to move up and down by the muscular motion of the stump.

This pin M is inserted through the eye or loop N, fig. 2, the shank of which slides in the tubular lever O, carrying an arch head, with teeth, and thus moving similar arch heads, P and Q, in opposite directions, the slender shanks of which form, when packed with cork, or other light but firm material, and covered with leather, the thumb and fingers of the hand.

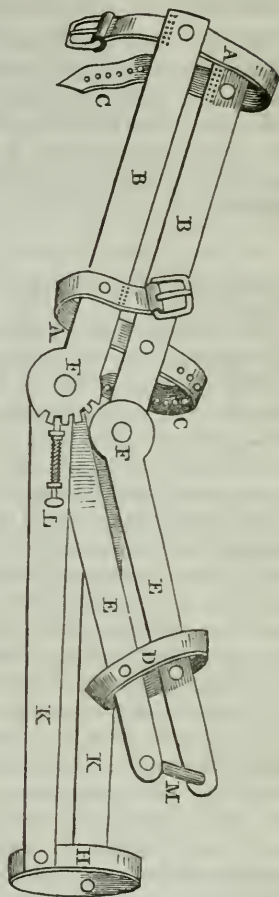
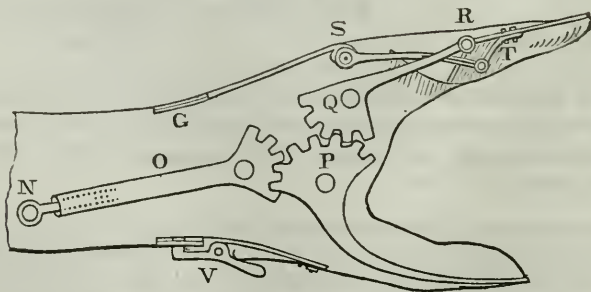


Fig. 2.

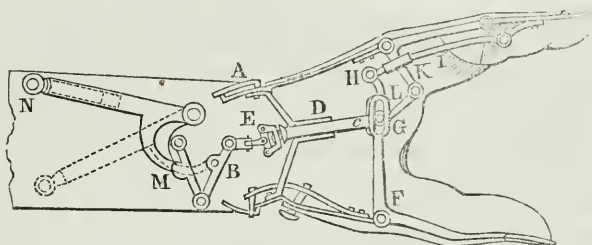


A second motion is given to the fingers at R, fig. 2, by means of a thin rod, or steel tendon, commencing at a stationary joint, S, terminating in a second joint or eye T, and perforating the finger rod near its outer joint.

The whole hand can be twisted round into several positions by the ring on which it is fixed revolving within the outer ring attached to the upper arms; and it is retained in these positions by means of holes, through which a spring catch plays, as seen at V, fig. 2.

There are two considerable deficiencies in this construction, first, that the hand cannot be turned even so much as a quarter of a circle from its horizontal towards a perpendicular grasp; secondly, that there is no movement equivalent to the usual bending of the wrist, which gives so great a variety of positions to the natural hand; indeed, it is not obvious, at first sight, how any other than an horizontal grasp can be given by this instrument, the movement of the pin M being horizontal, and parallel to itself. When, however, the hand is turned up to effect a perpendicular grasp, the action of this pin is oblique to the eye N, which then slides along it, and thus communicates its movement to the hand, full as forcibly as when it is in the horizontal position.

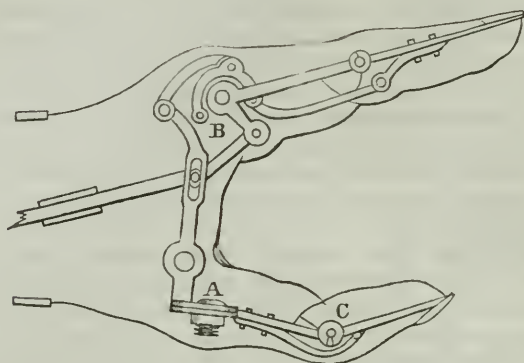
Fig. 3.



To obviate these defects, let the wrist A, fig. 3, be constructed with a hollow ball and socket movement, or other equivalent contrivance, having a range of about the eighth part of the circle; and let this be held fast at any required point by a spring catch as before, falling into a hole in the stationary portion, which must be drilled like a sieve, to suit every position. To the inner or movable portion the hand is fixed; and the movements of the fingers and thumb are communicated from the eye N, through a small rod B, turning on a hinge, and from thence, through a connecting-rod carrying universal joints at both ends, to a cylindrical rod, c. This rod slides freely in the tube D, and can permit one of these universal joints, E, to turn freely in a groove round it. The motion of the thumb piece F, which here, as in nature, is slower than that of the fingers, is derived from the centre pin of the joint G, passing through a slit or elongated eye in a rod hinged at the bottom, and on its prolongation above, carrying an eye, forming the joint H, from whence the steel tendon I, gives the second movement to the fingers as before. The bent finger-piece is also coupled with the end of the rod c by a short connecting piece, L. In some cases the rod B, which elongates the movement, may be dispensed with, and the universal joint E be connected directly with the joint M.

It is evident, from this construction, that the grasp will be equally firm in whatever position the hand be placed, either as it respects the bending of the wrist, or its rotary movement.

Fig. 4.



In the structures before described, a pressure or grasp between the thumb and fingers near their extremities is effected, and also the holding of substances of a moderate size near the middle of the hand; and, perhaps, this may in most cases be as much as is required where the person employing it has only lost one hand, and can, therefore, do any more difficult task with the other; but there are persons who have had the misfortune to lose both hands, in which case it is desirable to give this substitute all the efficient movements it is capable of. With this view, let the thumb piece, as at A, fig. 4, be furnished with a horizontal joint, capable of being screwed firmly against a spring plate, so as to create sufficient friction to prevent its turning with inconvenient freedom, (any required position may also be secured by a spring catch.) By means of this joint, the thumb can at any time be turned, as in the natural hand, out of the way of the grasp of the fingers, so that these may close round till they meet the ball of the thumb. This will enable many things to be held more conveniently and firmly than when the thumb meets the extended fingers at some intermediate point, and stops their further progress. To effect this greater range of the joints of the fingers, some little adjustment of the former plan is required. It may be effected many ways, but let the arrangement shown at B, fig. 4, suffice for the present to explain what is intended. And these movements being chiefly similar to those in fig. 3, will readily be understood, without further explanation, by reference to that figure. George Douseland can write, though with difficulty, with the hand as constructed in fig. 2, but an inventive young friend of mine has suggested the use of a spring movement in the last joint of the thumb, as at C, fig. 4, which will enable the pen to obey the pressure of the fingers backward in the down strokes; and to propel it forward in the up ones, as the fingers relax their force. This light elasticity of the thumb ceases when pressed back to its natural position by the joint being made incapable of receding further; and, hence, it will be no detriment to the firm grasp between it and the fingers.

To avoid confusion in the figures they are drawn so as to show the movement of one finger only; and in the hand worn by George Douse-land there is but one such movement, all the cork fingers being united side by side, and fixed to one broad thin steel plate, jointed, as shown in fig. 2, and covered with continuous leather, only stitched down to mark the distinction of the fingers under it. For common use in most cases, this will be sufficient; but where a more expensive apparatus can be afforded, and the appearance of having a real hand is an object, this thin steel plate can be separated into digits, though united at the base as the human hand, and jointed at the proper places in due proportion to each finger; and the tendons piercing these plates, may be either hinged to fixed joints, as at S, fig. 2, or worked from a horizontal extension of the joint H, fig. 3. All the required movements can be effected by catgut or other tendons attached to the joints of the fingers, as in the natural hand, and terminating in loops or eyes, on different parts of such a hinged bar as F H, fig. 3, so as to give them different ranges of tension to suit their respective purposes. This structure implies the necessity of a counteracting worm, or other spring movement, to extend the fingers and thumb again. Very light and elegant hands may be made on this plan, which would be suitable for the fair sex, and for light work.

I before said, the first drawing made of the hand for George Douse-land was on this plan; but I found that he could lift the weight of five stone with the stump, and that the strength, precision and durability of steel joints and tendons was more suitable to his work. These have also the great advantage of giving both extension and contraction, with no counteracting spring to weaken the effect. By one simple, lasting, and efficient means, both these actions are effected with perfect precision in all weathers.

This instrument, in all its forms, has only been represented as working when the spring bolt L, fig. 1, secured the lower arm from turning on the hinge F; but conceive this spring bolt occasionally drawn back, and secured from acting; and that a spring friction plate held the joint F, from turning, with less than three stone weight applied at the ring D by the stump, the grasp of the hand could then be used only up to that extent of pressure, sufficient, say, for example, to lift a can full of liquid; thus, if more than three stone force be applied, the friction of the joint will be overcome, the can will still be retained with the same power, but the movement of the joint will allow it to be lifted to the mouth. This is only one example of a very important principle, applicable to innumerable instances, which greatly increases the use of the apparatus.

The same principle may be carried out to a still greater extent in respect to convenient use, though not perhaps with so much power, by supplying the action of a strong spring in lieu of the friction plate. Let this spring be so arranged as to keep a nearly equal tension or pressure to retain the rods B and K, of the upper and lower arms, in a right line with each other, and to restore them to that position whenever the elbow joint is bent. By this means, supposing a glass, a

spoon, or other matter of light grasp be lifted to the mouth, as before described, it will not then be necessary to take it away from that position with the other hand as when the friction plate is used, for the reaction of the spring will continue the grasp, as the arm unbends by the downward movement of the stump.

Fig. 5.



One necessary aid to this instrument in all its forms is, to give support to its weight from the neck and shoulder; which, in the case of George Douseland is effected by a padded flat iron hook, surrounding a considerable portion of the neck, under the collar of the waistcoat, and passing behind it, so as to terminate on the shoulder, where it is cupped a little, to give it firmness of seat. To this part, the upper ring A of fig. 1 is attached by a couple of straps with buckles,—see fig. 5. By this means, the arm is not fatigued by the weight of the apparatus, and the joint F is at all times preserved in the same line of axis as that of the elbow joint, with which it has to move as on a centre common to both.

As the hollow ball and socket movement, previously suggested, will require very excellent workmanship to render it efficient, it will be as well here to remark, that with much coarser work the wrist movement may be effected by an external hoop, similar to H, fig. 1, containing a second, that can turn completely round freely within it, but confined from escaping by any of the usual means. The inside of this hoop should be cupped, so as to approach a section of the globular form; and a third hoop, externally, a similar segment of a globe, but a size smaller, must fit, without much nicety of adjustment, within the second. An axis passing through the centre of both these spherical portions is fixed to the inner one, but turns freely in a collar in the second the end being flush with its exterior surface. The ball and socket action, so far as it is used, is here derived from the one turning on an *axis* within the other, and not from the accurate fitting of these spherical portions. Any required position of the hand, which is attached to the inner ring, can be secured by a catch and holes to receive it, as before. On the centre of this axis, the tube D, fig. 4, may be fixed.

I am sorry to give you so many dry details, of no interest excepting to workmen, to whom, in fact, this communication is chiefly addressed, and without whose aid those who require the use of this instrument cannot procure it.

A much more simple and less costly hand than that worn by George Douseland, at the Polytechnic institution, might be made, chiefly of wood or bone, for poor persons; and I hope, that all good workmen,

who live by the use of their own hands, will, when called upon to make these humble substitutes for the poor man's *capital*, (for so, in fact, the hand is to him,) exercise a generous sympathy towards the sufferer.

London Mechanics' Magazine.

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*Anastatic Printing.*

Early in October of 1841, we received from a correspondent at Berlin, a reprint of four pages of the *Athenæum*, (which contained three wood-cut illustrations,) published in London only on the 25th of September. As we stated at the time,—“The copy was so perfect a fac-simile, that had it reached us under any other circumstances, we should never have suspected that it had not been issued from our own office—and even with our attention thus specially directed to the subject, the only difference we could discover was, that the impression was lighter, and that there was less body in the ink; from which we infer that the process is essentially lithographic, the impression of the original page being, in the first instance, transferred by some means on to the surface of the stone or zinc plate. This, however, is but a conjecture, and our correspondent is unable to throw light on the subject. In reply to our urgent request for further information, he thus writes:—

“*Berlin, Nov. 25.*

“I have not ceased to exert myself to obtain the information you desire, but all I can collect is briefly this:—The process by which these fac-simile reprints are produced, was discovered by a gentleman at Erfurt, and is kept a profound secret. I have since seen a copy of an Arabic MS. of the thirteenth century, and of a leaf of a book printed in 1483, both of which have been produced without the slightest injury to the originals, so that your Bibliomaniacs may despair of ever again seeing a unique copy. The parties in possession of the secret are about to re-publish here the *Athenæum*, and are to commence operations with the first number of the coming year. I have seen the draft of the Prospectus, in which they offer to supply the trade at the rate of three thalers (9s.) per annum. They will be content too, I understand, with 300 subscribers, and from this fact, you may form a conjecture as to the probable cost of the process, which must be below what the mere paper costs you.”

The copy we received was submitted by Lord Monteagle to the commissioners appointed to inquire into the Exchequer Bill forgeries, in proof of the difficulty of guarding against fraud by any mere typographical arrangement. From that time, we heard no more of this wonderful discovery. We now learn, that the discoverer was M. Baldermus, now of Berlin, and that the process has been communicated to Mr. Woods, of Barge-yard Chambers, Bucklersbury. Whatever may be the results of such invention, our duty is to record the fact, and throw such light upon it as the state of our information permits. Thus we learn, that the original to be copied is prepared by

peculiar chemical means, and pressed in tight contact with metallic plates, whereby a reversed fac-simile is obtained ; and after the metallic plates have been prepared by a second process, (which prevents the adherence of ink on the blank spaces) the impression is inked up with rollers, and printed from in the usual manner of surface-printing. Eventually, the proprietors are sanguine of being able to print from cylindrical surfaces, and consequently produce an unlimited number in a short time. Both sides of a newspaper can be transferred simultaneously on contiguous cylinders. Nothing can exceed the ease, elegance, and rapidity of the whole operation. The specimen worked-off for us, a page of *L' Illustration, Journal Universel*, was produced in less than a quarter of an hour from the first preparation. In fact, allowing seven or eight minutes for the absorption of a dilute acid, the thing is done as quickly as two sheets of paper can be successively placed on a plate of zinc, passed under the roller, and again withdrawn. Such an agent as this is, it is obvious, of tremendous power; if abused, it is fraught with the most fearful consequences; under proper and legislative regulation, it may become the greatest of blessings. But such an instrument most certainly must not be suffered to work out its own issues without guidance and without law, solely at the caprice and uncontrolled motive of self-interest. It is inconsistent with our present social condition, and must either modify or be modified by it.

London Athenæum.

This mode of copying engravings and letter-press, appears to have nothing whatever of novelty in it. A specimen of the same thing will be found in Senefelder's original work on Lithography, printed in Sienna, 1818. In this country it has long been known and practised. The members of the Franklin Institute will scarcely need to have recalled to their recollection the engraved stone, with the specimens of copied letter-press, which were deposited in our hall, for public inspection, in October, 1839, by Mr. Joseph Dixon, of Taunton, Massachusetts. A mode somewhat similar has been employed, under the name of Zincography, in London, many years since. And during the excitement caused by the French Revolution, in 1830, the French papers were copied and a new edition issued in Brussels in a few hours after their arrival, by an analogous process.

We insert with this notice, the specimen sent to us by Mr. Dixon.  
COM. PUB.

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#### *Nasmyth's Patent Steam Hammer.*

Having, on several occasions, directed attention to Mr. Nasmyth's novel and ingenious invention, it must be interesting to our readers to be informed of its rapid and most successful progress towards general adoption, and which, we are glad to find, is giving the very highest satisfaction to all the parties who have availed themselves of so powerful and useful an assistant. One of the hammers was put in operation for the first time in Scotland, on Monday week, at the Dundyvan



The specimen of Transfer  
on the opposite page, - prepared  
for the Journal of the Franklin  
Institute, - was made in our pres-  
-ence this day, by Mr. Joseph Dixon,  
from an Arabic work, printed  
in 1767.

Taunton Ms. Oct: 28<sup>th</sup> 1839.

Marcus Morton

Francis Baylies.

Henry Williams

James L. Hodges.

And<sup>rs</sup> Bigelow

يَمِينًا وَيَسَارًا وَهُوَ خَائِفٌ مَرْغُوبٌ فَنَظَرَهُ التَّعَلُّبُ  
فَتَضَحَّكَ عَلَيْهِ فَقَالَ لَهُ الْأَسَدُ بَيْتَنَ مِنَ الْحِرَدُونَ  
خَوْفِي إِنَّمَا أَكْبَرُ عَلَى احْتِقَارِي ❦

هَذَا مَعْنَاهُ ❦

أَنَّ اللَّهَوَانَ عَلَى الْعَاقِلِ أَشَدُّ مِنَ الْمَوْتِ ❦

أَسَدٌ وَنَوْمٌ ❦

أَسَدٌ مَرَّةً أَرَادَ يَغْتَرِسُ نَوْمًا فَلَمْ يَجْسُرْ عَلَيْهِ لِشِدَّتِهِ  
فَمَضَى إِلَيْهِ لِيَحْتَالَ عَلَيْهِ قَائِلًا أَعْلَمَ أَنِّي قَدْ دَبَحْتُ  
حَرُوفًا سَمِينًا أَشْنَهِيَ أَنْ تَأْكُلَ عِنْدِي فِي هَذِهِ اللَّيْلَةِ  
خَبِيرًا

#### NOTÆ AD FAB. IV.

In speluncam quandam ] *Arabice* in quandam speluncarum. *Observent autem studiosi*, vocem بعض, quæ collective passim accipitur, ❦ quosdam, non-nullos, partem significat, etiam singulariter interdum sumi pro احدي ❦ sine ullo tamen generis respectu; ut hic ❦ locis aliquot aliis in hoc opusculo.  
لكبي \*

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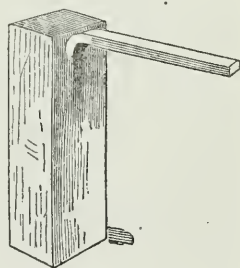
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Iron-Works, near Glasgow, and, as might have been expected, attracted a good deal of interest and public attention; its weight is nearly 2 tons 12 cwt., and the precision with which the patentee can direct, or control, at will, the power necessary for making a slab of half a ton of iron, or cracking a nut of an inch circumference, of shingling a bloom of iron, or shutting the lid of a snuff box—in short, of simply touching, or actually crushing, anything “from a needle to an anchor”—is the most convincing proof that need be adduced of the adaptation and consequent importance of this patent steam hammer.

There are upwards of thirty now in action in various parts of Europe, all of which are giving the highest satisfaction, and more than realizing the most sanguine hopes entertained of its practical value in facilitating the working of masses of wrought iron, as well as materially improving its quality. In respect to this subject, it may be interesting to some of our readers to know, that “puddled balls,” hammered under this machine, have the cinder so entirely driven out, as to yield at once a quality of iron at least advanced an entire process—that is to say, the result, as to quality, of this first stage in the manufacture of wrought iron, is equal to that of the second—a fact that will be duly appreciated by those practically conversant with the manufacture of wrought iron. The facilities of “up ending,” as it is termed—that is, of turning a mass of iron on its end, so that the *ends* of the mass may be hammered compact and flat, as well as the *sides*—is rendered so simple and easy a process under this hammer, by reason of the great range of fall which can be commanded at pleasure, that it is an advantage which appears to be highly valued by the iron manufacturers, as the entire material of the mass is in this way rendered available, when rolled out into a bar or boiler-plate. In the process of piling or welding the slabs of iron which go to form large boiler-plates, the most important facilities are obtained from the use of the steam hammer, not only from the vast energy of the blows serving to knock out, in the welding, all cinder and scoriæ by a few masterly and truly effective blows, but also by enabling the mass so produced to be turned upside ways, edge ways, and end ways, so as to be made into one compact rectangular mass—this being the natural result of the wide range of height of fall of the hammer, as well as the important fact of the hammer and anvil face being at all times parallel to each other. It is amusing to see the *kindly* way in which it pats a tender, spongy, puddled ball, and then, when it is ready and fit to receive a blow, to see the hammer “walk into it,” in such style as to send the cinder squirting from its most inward recesses—the whole resulting in one compact neat mass of almost perfectly pure iron. But, when it is known, that Mr. Nasmyth has now in hand forty-eight steam hammers for various parts of Europe and America, such a fact speaks sufficiently well for its merits being appreciated.



Mining Journal.

*Improvements in Coating Iron with other Metals.*

We copy from the *Civil Engineer* the following notice of the patent recently obtained by Messrs. Morewood and Rodgers, for improvements in coating iron with other metals:—The first part of these improvements relates to a mode of coating articles of cast iron with tin or other metal. This part of the invention is confined to the combined process of casting iron in metal moulds, and then coating such articles with molten metal, the process being conducted by first cleaning the surfaces in the ordinary manner, and then coating them in a manner hereinafter to be described.

The second improvement relates to a mode of treating articles of iron before submitting them to the melted metal to be coated. In carrying out this part of the invention, the patentees provide an iron box, or trough, about seven feet long, and of sufficient width to contain the plates of metal to be coated; this box is provided with a number of ribs, or bars, so as to prevent the plates from touching one another; in the bottom of this box is placed sal ammoniac, to the depth of three or four inches; a fire is then lighted under the box, the heat of which causes the sal ammoniac to give off vapor to such a degree as to exclude all atmospheric air; after this process the sheets, or articles of iron, may be immersed in melted metal, for the purpose of coating them in any convenient manner.

The third part relates to a mode of treating tin which has become injured in the process of tinning. In coating iron with tin by the ordinary process there is considerable waste, owing to its passing through the oil or tallow employed in the tin bath; this part of the invention, therefore, consists in submitting the waste, or spoiled, tin to a red heat, and then allowing it to cool; after which it is to be placed in an earthenware vessel and covered with muriatic acid of commerce, which, in an ordinary temperature, must remain about two days, at which time the acid will have become sufficiently neutralised, and may then be drawn off; by this means the inventors obtain chloride of tin, which they employ in the process of tinning metal.

The fourth improvement relates to a mode of coating sheets of iron with lead, or alloys of lead and tin, the latter being in the proportion of (not exceeding) 15 per cent., by means of a flux, containing sal ammoniac and chloride of zinc without the aid of tallow. In carrying out this part of the invention, the patentees prefer to use a flux composed of three-parts of chloride of zinc, without any oil or other fatty matter; the sheets of iron may be dipped in the bath of molten metal in the ordinary manner.

The last part of these improvements relates to an after coating of lead or alloy of lead—that is to say, coating articles which may have received a previous coating of zinc or alloy of zinc. In the case of iron which has received a previous coating of tin or some other metal, and afterwards to receive a coating of zinc, the inventor proceeds by melting the metal in an iron pot, and then covering its surface with a suitable flux, which may be composed of two parts of chloride of

zinc, and about one part of oil or tallow ; the articles to be coated are then to be immersed in the metal, and allowed to remain until they become of the same heat as the metal, (care being taken that the metal is not too hot, so as to melt the previous coatings,) they are then withdrawn, and shortly afterwards dipped into water, and then brushed with sawdust, to remove the flux.

*Ibid.*

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*Improved Manufacture of Cast Steel.*

Although it has long been known to chemists, that the only essential difference between cast iron and cast steel consisted in the relative proportions of carbon contained in the two substances, it has yet been found impracticable hitherto to produce the latter substance at a less cost than from four to eight times that of the pig iron from which it is made. For instance, if pig iron, made with charcoal and the relative materials suitable for the manufacture of steel, cost 6*l.*, it will be found, that according to the processes now universally used, cast steel cannot be made from such iron at a cost of less than 29*l.* per ton, in the ingot; and for the superior descriptions, the raw material of which bears a monopoly price, the cost of cast steel in the ingot, comes to nearly double this price. The cause of this cost arises from the great waste and labour necessary to deprive the pig iron, in the first instance, of the whole of its carbon, amounting to about 5 per cent., and to reduce it into malleable iron; this iron is then recombined with about 1 per cent. of carbon, in the process of cementation, forming blistered steel, and to produce cast steel it is necessary to melt the blistered steel in crucibles of fire clay and run it into moulds. If the cost of pig iron of medium quality, fit for making steel-iron, be 6*l.* a ton, the loss on converting it into bars is one-third, or 2*l.* more; the average cost of labor, fuel, and other charges, on making a ton of charcoal bars, will be 5*l.* more; the foreign merchant's profit, freight, insurance, import duty, and other charges, will be 4*l.* a ton more; the profit of the importers in this country will be 2*l.* a ton more; making the cost of bar iron, of medium quality, fit for making steel, 19*l.* a ton to the steel manufacturer here; in making this iron into steel, he incurs a further expense of 1*l.* 10*s.* for conversion into blistered steel, and about 7*l.* 10*s.* for making the blistered into double shear or cast steel in ingots; making the cost of these two articles of medium quality about 29*l.* a ton; and all this cost of 23*l.* a ton is necessary to get rid of the 4 per cent. of carbon in the cast iron, beyond the proportion required to form cast steel. It may be observed, that, by a recent improvement, cast steel can be made capable of welding to iron with the same facility as shear steel, and the manufacture of the latter article is rapidly giving place to the increased use of cast steel. Before this improvement, it was calculated that the quantity of cast steel annually made in England was about half the whole quantity of steel manufactured; at present it probably exceeds two-thirds of the whole quantity. The solution of the problem of producing cast steel direct from cast iron without incurring the enormous expense hitherto inseparable

from the old process, has engaged the attention of scientific men since the time of Reaumur, whose work appeared nearly a century ago, to the present time, without having produced any result of the least value. The process of making natural steel, or that of decarburating pig iron, to a certain extent in a charcoal refinery, and then drawing it into bars under the hammer, has been known for ages; and, for a long period, was the only known method of making steel in Europe; but the steel thus made is inferior to all other kinds that are manufactured, and its quality is such that it is not used in this country for any purpose whatever; even this inferior article, however, costs about three times the price of the pig iron from which it is made, and its price quoted in the Prices Current of the day, in bond for export, is about 17*l.* a ton. At length, however, this object is announced as having been accomplished by a gentleman, who states the apparent paradox, that he is able to produce cast steel at a cost not exceeding that of pig iron of a quality suitable for the manufacture of steel. Of the importance of such a discovery, supposing it brought into practical operation, some opinion may be formed, from considering that steel made in this manner may be sold at half the present selling price of that of medium quality, made in the usual way, at a profit of 100 per cent.; and that the quality of it, according to the statement of the discoverer of the process, will be equal to that now made from the most expensive foreign iron; it is also stated that the steel is suitable for every purpose for which steel is now used—from coach springs to surgical instruments—and that, consequently, this process must entirely supersede all those at present in use for making the various descriptions of steel now used in the arts. The quantity of steel of all kinds now annually manufactured in this country alone, is estimated at 25,000 tons; if the *average* value of all kinds of shear and cast steel in ingots be taken at 28*l.* a ton, the value of the whole quantity manufactured will be 700,000*l.*; if cast steel can be made by the new process, so as to admit of its being sold at half this price, with a profit of 100 per cent., there will be a saving to the public of 350,000*l.* a year, and a profit to the manufacturers of the steel, of 175,000*l.*

It is stated to us that a suitable material for this manufacturing steel may be had in great abundance in this country, and the manufacture can be carried on to any extent, commensurate with the increasing consumption, which will be the certain consequence of such an enormous reduction in price to the consumer, without being dependant, as the steel manufacturers of England have hitherto been, upon foreign countries for the supply of their raw material, and the scarcity of the best qualities of which has hitherto enabled the possessors of such material to obtain for it an enormous monopoly price. The steel made by the new process would all be of uniform quality, and trials on a large scale, even in this stage of the matter, have satisfied some of the best judges in this country, that it is impossible to surpass it as regards its quality.

*M. Schafhaeutl's Method of Purifying Castings applied to the Moulding in Second Fusion.*

[Abridged from the *Moniteur Industriel*.]

No metallurgist is ignorant of the process adopted by M. Schafhaeutl for refining sulphurous, phosphoric, and arseniferous castings: hitherto its success in Germany has been complete, and the method appears so simple and correct as to warrant the anticipation of the best results. The ingredients of his composition consist of  $1\frac{3}{4}$  lbs. of peroxide of manganese,  $3\frac{3}{4}$  lbs. of chloride of sodium, 10 ozs. of clay—the two last, of course, being the essential elements. The mixture being subjected to the temperature of a puddling oven, instead of volatilizing itself, decomposes; the sodium seizes the oxygen of the air or of the peroxide of manganese, and is transformed into soda, which unites with the silica and alumina of argine, and gives place to a silicate and aluminate of soda, which mix themselves with the scoriæ. The protoxide of manganese is converted afterwards into silicate, and thus diminishes the waste of iron; and the chlore being at liberty seizes on the sulphur, phosphorus, and arsenic, to form volatile chlorures, which escape by the chimney. We see, therefore, that the process has the effect, not only of purifying the castings, but, probably, of materially shortening the labor; and it is a question, whether, by a slight modification, it might not be adapted to the purifying castings for moulding in second fusion. But, for this it will be necessary, in the first instance, to lessen the proportion of peroxide of manganese. In fact, the contact of the metals with oxygen is wholly unnecessary, decarbonation of the castings not being intended, and as to the oxidation of the sodium, the current of air produced by the pipes is more than sufficient for that purpose. But, in applying the principle to the system in question, scoriæ were generated to a great extent, and the clay used in M. Schafhaeutl's, unfortunately does not tend to diminish this difficulty, but rather creates others, waste, trouble; &c. But, then, how are we to produce decomposition in the marine salt? If we substitute hydro-chlorate of ammonia, we shall have, first, the advantage of its salt being richer in chlore than marine salt; secondly, its requiring a far lower temperature to get volatilized; thirdly, the sal ammoniac being very easily decomposed by the iron; fourthly, the hydro-chlorate of ammonia does not augment the scoriæ; and, lastly, it contains from seven to eight per cent. of hydrogen, which would render the purification more complete; the only objection to this is the difference of price between the ammoniac and the marine salt. The question, then, is, would that objection be compensated by the undeniable advantages of the substitute? To purify the castings of sulphur, chlorine of sodium must be largely used; but this, and the difficulty of cooling, is overcome by the sal ammoniac, for the latter considerably raises the temperature of the furnace; and if this be established, we know nothing to prevent iron-masters from purchasing hydrochlorate of ammonia at a low rate, and then applying the carbonizing ovens, they would thus procure more sal ammoniac than they

could possibly use. But, though this substitution may thus be beneficial in the cupolas, we doubt if it would be so in the reverberating furnaces, as in the latter the intimate contact of the sulphurous casting with the sulphurating matters, exists only by a stirring about, more or less prolonged; and this stirring, a *sine qua non* condition of a sufficient renewing surface, may, if great care be not taken, occasion great inconveniences; the casting exposed on a large surface to the action of the air, drawn by the flame, will partly refine itself, or, at least, whiten; this, however, may be obviated, we think, by the admixture of a small proportion of carbon, which will preserve, as much as possible, that which constitutes the casting; thus, then, we have freely given the various advantages and objections which are prominent in the application of M. Schafhaeuti's system to the purification of castings in second fusion, by the substitution of hydro-chlorate of ammonia; it remains to be proved whether its benefit will counteract the difficulties which present themselves. The suggestion, however, is at least valuable, and we shall anxiously watch its issue. Ibid.

*On the Mean Year, or the Solar Variation of the Barometer, in the climate of London. By Mr. LUKE HOWARD.*

Mr. Howard exhibited curves which showed the mean annual pressure and temperature, and the quantity of rain, during a cycle of eighteen years. This period he conceived long enough to eliminate the lunar influence which meteorologists had for some time been willing to admit the existence of, and to exhibit that of the sun alone. The development of Mr. Howard's views depends so much on explanations in detail of the diagrams, that it is not possible for us to give them. The observations seemed to show a succession of nine warm and nine cold years, with—as might be expected—occasional irregularities and similar successions in respect of rain, but with a cycle of only half that duration. In the annual curves, deduced from the monthly means of the whole period, much greater uniformity is observed, and both the rain and barometric pressure follow more closely the march of the temperature.

The Rev. Dr. ROBINSON expressed a hope that these speculations of Mr. Howard might be confirmed, or rendered more precise, by the extensive observations now established at Kew. He could not help regretting, however, that Mr. Howard had not conjoined the state of the wind and hygrometer; as it was obvious from Colonel Sabine's paper on the Meteorology of Toronto, that the latter was intimately connected with barometric indications, while it was equally plain, that the former influenced the amount of rain.

Proc. British Assoc.—London Athenæum.

*Transactions of the Paris Academy of Sciences.—Dec. 23.*

Messrs. Elie de Beaumont and Dufrenoy presented a lithographic map printed in colors by a new process, discovered at the Royal Printing-office of Paris.—A letter was received from M. de Humboldt,

stating that M. Ehrenberg has just made some new discoveries of infusoriæ still more wonderful than any he has hitherto announced.—A paper was received from M. Pirsis on the relations that exist between the configuration of continents and the direction of the chains of mountains. He finds that, in general, the coasts are parallel with the chains of mountains.—M. Arago presented, in the name of M. Aimè, two instruments, one to ascertain the direction of submarine currents, the other to measure their speed. These instruments were accompanied by an account of several experiments which had been made with them. It states, amongst other things, that the greatest speed of the currents on the coasts is on the coast of Africa between Algiers and Bona, and not, as is generally supposed, between Gibraltar and Algiers, and that in the Straits of Gibraltar there are three parallel currents. Near the coasts the direction is from east to west, whereas the central current proceeds constantly from the west to the east; the latter is 7 miles wide between Trafalgar and Cape Spartel. The width of the strait, at its narrowest part, is 12 miles; between Trafalgar and Cape Spartel, it is 27 miles; and 15 miles between the Point of Europe and Ceuta.—M. Pouillet gave an account of some experiments, to ascertain the rate of rapidity of electricity and the explosive speed of gunpowder. As may be supposed, the rapidity of the electrical current is found to be almost incalculable. As regards the rate at which the explosion of gunpowder proceeds, he has ascertained that the time which elapses between the snapping of the capsule of a gun-lock and the departure of the ball from the barrel is the one hundred and fortieth part of a second. The electrical current would hardly be the three thousandth part of a second in performing the same distance.—In a letter from M. Jobard, of Brussels, that gentleman states that, when at Munich, he observed that the stone staircase of the bronze obelisk to the memory of the Bavarians who fell in the campaign of Russia was perfectly free from green mould in the parts washed by the rain. He is of opinion, that the oxide of the copper carried down with the rain destroys this vegetation; and recommends that a solution of copper should be tried in the cleaning of statues covered with vegetable matter.

*Jan. 6.*—Several communications were received of real or imaginary improvements in railway traveling.—In a former notice, we mentioned an apparatus, by a M. Chuart, the object of which is to indicate the danger from fire-damp, or the escape of gas. M. Chuart's invention consists of a globe, or ball, contained in a chemical solution highly sensible to any deterioration of the atmosphere, and acting upon a lever, which sets an index in motion, and thus shows the vitiated state of the atmosphere, whether in a mine, or elsewhere, long before the common air can be so saturated with gas as to explode on the application of a light. M. Chuart has added to his invention an alarm bell, which is struck by the lever when the ball is thrown off its equilibrium by the vitiated state of the atmosphere. Since M. Chuart first exhibited his apparatus he has made a great improvement. His ball was originally of glass, which was not only too heavy, but also liable to breakage. He now makes it of copper, so very thin that its weight

is almost nominal, and yet it is perfect in every part. We understand that he arrived at this perfection by means of the galvanic process, which gives a thinner substance than any mechanical means could effect consistently with the compactness that is required for the certain operation of the apparatus.—A paper was received from the Abbé Cochet, on the disappearance of the vine from Normandy.—M. Lewy made a communication, stating that he has analyzed several descriptions of wax obtained from different sources, and all of which, he says, have an affinity more or less to bees'-wax. He concludes that bees do not produce wax from any natural process of their own, but merely collect it.—A communication was received, announcing that the Abbé Baldaconi, conservator of the Museum of Natural History of Sienna, has discovered a means of petrifying animal substances. The process consists in the immersion of the substance to be hardened, for a long time, in a strongly charged solution of twelve parts of bichloruret of mercury, and one or two parts of hydrochloruret of ammonia. By this process, the natural color of the objects is preserved, which is not the case if the bichloruret of mercury be used alone. With the letter announcing this fact, was forwarded the liver of a dog, preserved, retaining its natural form and color.

*Jan. 13.*—A communication was made of the discovery of a comet, at Berlin, on the 28<sup>th</sup> ult., by M. d'Arrest.—A letter was read from Mr. Maclean, of the Cape of Good Hope, announcing that he had seen there, in October last, the comet discovered by M. Mauvais, and which was no longer visible in our atmosphere.—A letter from M. Le Bœuf informs the Academy that there is in Chili, the country of the Peruvian bark, a plant which is esteemed its equal, but is very little known in Europe. It is the canchalagua.—The following curious letter was received from a wood-cutter, named Terebol, of Brionne:—Since it appears to be the fashion to make the Academy acquainted with everything at all extraordinary that is witnessed for the first time, a poor wood-cutter may be permitted to communicate an observation, which has certainly been made also by several of my comrades, but which I have some reason to believe will be entirely new for Messieurs les Académiciens. I have remarked that whenever a flock of sheep passed near the place where we were occupied in stripping the oaks of their bark for tan, it was absolutely impossible for two or three hours, and by the means which we usually employ, to strip off the bark of a diameter of more than three or four centimètres. My comrades attribute this strange fact, which I remarked for the first time more than five years ago, to the volatile sweating of the sheep, which has the property of coagulating instantaneously the sap near the bark, and to prevent its free circulation for two or three hours.

*Athenæum.*

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#### ERRATA.

Page 13, line 2, for "teeth" read "tubes."  
 " " 10, " "Shelly" " "Shelby."

JOURNAL  
OF  
THE FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY.

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AUGUST, 1845.

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*“Account of the Railway from Amsterdam to Rotterdam, and of the principal works upon it.” By the Chevalier FREDERICK WILLEM CONRAD, M. Inst. C. E.; translated from the French, by CHARLES MANBY, Assoc. Inst. C. E. Secretary.*

This railway, the first that has been constructed in Holland, is due to the enterprise of a public company, called “The Railway Company of Holland,” whose affairs are managed by a council of administration, consisting of five commissaries and the engineer. The difficulties of construction, arising from the peculiar physical character of the locality, were amongst the least that the company had to contend against; the directors were, however, satisfied that the utility of the undertaking would be finally understood in the country, and that by perseverance every obstacle would be overcome.

The company was formed on the 8th of August, 1837, at Amsterdam; and, within a short period, the statutes received the royal sanction. but, no sooner had the contract been made for the execution of the first division, from Amsterdam to Haarlem, than numerous law-suits arose, owing to the hostility of the proprietors of the land over which it was intended the railway should pass,—the consequent difficulty of expropriation,—and serious discussions with the engineer, to whom, at that period, the execution of the line was entrusted, and which terminated in his resignation, caused great delays, which were prejudicial to the undertaking.

At length, the government, at the request of the council of administration, appointed the author of this paper “Engineer director,” and he entered on his duties in March, 1839. After a minute inspection

of the line, he found it necessary to complete the first division between Amsterdam and Haarlem, according to the designs of the former engineer; but to adopt different and more eligible plans for all the other divisions. The first part was opened on the 20th September, 1839; and the dispatch that had been used, enabled the council to announce, at the general meeting held in April, 1840, their intention to continue the execution of the remainder of the line, without delay.\* The assent of the government being granted, the greater part of the year 1840 was occupied in gaining the concurrence of the regencies of the different towns and the "polders"† through which the railway would pass, and in effecting the expropriations.

In the beginning of the year 1841, the first contract for works was made, including the bridge over the river Spaarne, at Haarlem. This bridge, which is of iron, has six openings; the piers are of brick-work, faced with cut stone. The two middle openings have an iron swing bridge of a very simple and solid construction, which opens and shuts both openings at the same time, to render the passage of vessels as rapid as possible; as between fourteen and fifteen thousand pass through annually. The principal beams of this swing bridge are each upwards of 23 metres long (= 75 feet 6 inches,) and were cast in a single piece; the whole bridge weighs upwards of 110 tons; and the machinery for moving it is so perfect, that one man turns it easily in two minutes. There is also a method of holding the bridge firmly shut during the passage of the train, at which times alone it is closed, and a self-acting signal is attached to it. During the construction of this bridge, the channel of the river was diverted, that the navigation might not be interrupted, and the whole was completed in one season.

There are also five fixed bridges, of the same style of architecture, over the canals within the town of Haarlem, the station at which place is neat and simple.

After much difficulty in obtaining possession of the land for the railway, a contract for the cuttings and embankments, at a given price per cubic metre, was made, to be executed as fast as each individual portion should be obtained, either by private purchase or otherwise; by this means, much time was saved, and the line was completed to Hellegom, during the season of 1841.

At Vogelenzang, near Bennebroek, the canal of Leyden, and the high road are both crossed by a trellis bridge of 54 metres in length (= 177 feet,) at an angle of 30° with the canal. This bridge is built entirely of red deal, excepting the roadway beams, which are of oak, and is

\* The divisions of the line are—

	Metres.	English.
1° From Amsterdam to Haarlem	16817.40	= 18381.4
2° " Haarlem to Leyden,	28270.30	= 30891.1
3° " Leyden to the Hsue,	15303.80	= 16726.2
4° " the Hsue to Rotterdam,	24000	= 26232.0
Total,	84391.50	92230.7

or about 52½ English miles; with fifty-eight bridges in the three first divisions.

† The "polders" are the spots of land which have been drained and are now cultivated: their level is usually below that of the sea.

formed by three series of planks, crossing each other in the form of trellis-work; there are three openings, of which, those on either side are each 98.5 metres (= 328 feet 4 inches) span; and the centre one is 34 metres (= 111 feet 6 inches) span; the trains pass without causing any vibration.

The next step was, to make a contract for the trussed timber bridge, to cross the towing path, at an angle of  $60^{\circ}$ , near Leyden; for which the span was required to be 17.20 metres (= 56 feet 5 inches.)

Near this spot is the "Warmonder Leede," one of the navigable canals, which, at the same time, act as drains for conveying water from the interior of the country, into and out of the lake of Haarlem, by the dykes of Katwyk, as well as serving for commercial and agricultural purposes. The Regency of Rhymland insisted, that the bridge to cross this canal should have five openings, each of 6.30 metres (= 20 feet 10 inches,) of which the centre one should have a swing bridge for the facility of the navigation of the canal.

This is of a novel construction, on the system of a sliding bridge; it is built of timber, and the platform is easily moved by one man.

The nature of the soil from the "Warmonder Leede" to the town of Leyden, was such as to render it necessary to form the railway on fascines or faggots. This plan was also necessary on all the first part of the line; and even at the Leyden station, the whole of the buildings were erected upon a similar foundation, which appears to answer very well.

Beyond Leyden, the railway crosses the Rhine at an angle of  $82^{\circ}$ , by a trussed timber bridge with five openings; the three centre ones have each a span of 10 metres (= 32 feet 10 inches,) and the two side ones are each 6 metres, (= 19 feet 8 inches) span. One of these latter is for the navigation of the river, and is furnished with sliding platforms opening both ways; they are easily managed by one man.

It was not until the end of the year 1841, that the company obtained possession of part of the line of railway at Sloterdijk, in the first division, after a law-suit of four years' duration, relative to the expropriation: and, after being obliged to pay a large sum to the proprietor, for the permission to pass, temporarily, during the law-suit; without which, the first division between Amsterdam and Haarlem could not have been opened.

These difficulties were encountered throughout the whole line, to such an extent, that, at a short distance from Leyden, the obstinacy of a single land-owner entirely stopped the progress of the works, and obliged the company to build a temporary station for that town; without this step, the opening of that part of the line would have been retarded for three or four years, there being no legal means of accelerating the process of expropriation. The line was then opened from Haarlem to the immediate neighborhood of Leyden.

In the course of the year 1842, the whole of the second division, and great part of the third, were completed. Several aqueducts, five large bridges, and a number of small ones, were built; the latter being all over navigable canals, were made to swing on simple brackets; the permanent station at Haarlem was completed; the foundations

were laid of those of Leyden and Amsterdam; and the workshops for the repairs of the engines, &c., were finished.

These circumstances are only mentioned to shew, that, considering the delays occasioned by the defective jurisprudence in the matter of expropriation, more than common diligence had been used to enable the line to be thus far opened.

After the opening of the second division, several of Stephenson's new patent locomotive engines were added to the stock of the company; and, after ample trial of their qualities, they were considered to be the best engines in the service.

A part of the third division was opened as far as Voorschoten, in the month of May, 1843, and thus, with the aid of omnibuses and diligences, the line was completed as far as the Hague, although, owing to the legal difficulties already named, the swing bridge to cross the Hague and Delft canal could not be constructed, nor the permanent station at the Hague be built. These latter works have only been completed in this present year, (1844.)

Such were the difficulties the company had to contend with, from the delay caused by the defective state of the law of expropriation, and the rapacity and prejudice of the proprietors, over whose land the line had to pass, that it was only on the 6th December, 1843, that the railway was completely opened for public use, all the works, as well as the different stations being completed, and a simple and effective system of management established.

The opening of the railway took place, with much ceremony, on the day above named, being the anniversary of the birth of the King, in the presence of his excellency the Minister of the Interior, who was conveyed by it from the Hague to Amsterdam, where, on the same day, he was present at the opening of the Rhenish Railway, from Amsterdam to Utrecht.

The stock of the company now consists of thirteen locomotive engines, with their tenders complete, and one hundred and three carriages of three different classes, which number will be considerably increased.

From the opening of the different divisions, up to the 1st December, 1843, the locomotive engines have traversed a distance of 386,124 kilometres (= 239,786 English miles,) and 1,513,935 passengers have been conveyed.

In consequence of the difficulties experienced through the defective law of expropriation, a petition for its revision was presented to the States General, and, from its favorable reception, it is presumed that such a law will be passed, as will facilitate the formation of railways throughout the kingdom, and will cause the speedy extension of the present one as far as Rotterdam, thus uniting two cities so long celebrated in the annals of commercial enterprise.

The rails used in the permanent way are of a bridge form, weighing 30 kilogrammes per metre (= 60 lbs. per yard;) they are fixed by screws, upon longitudinal timber bearings, of Riga red deal, with sleepers of the same timber, halved into them, and secured by oak wedges. The ends of the rails are fastened by nuts and screws,

through the longitudinal bearings, with joint plates and cramps. This method of fastening is said to be very complete, and the motion of the carriage over the joints is without shock. The gauge is 2 metres (= 6 feet 6 inches English) from centre to centre of the rails; and the cost of each kilometre (= 0.616 of an English mile) of single line of railway laid, is 17,700 florins (= £1475, or £2,394 10s. per mile.)

The general width of the top of the earth-work for rails is 9 metres (= 29 feet 6 inches English.) The inclination of the slopes of the embankment is twice its vertical height. The side benches vary in width between 1 metre and 2 metres (= 3 feet 3 inches and 6 feet 6 inches English.) The ditches are 4 metres (= 13 feet 1 inch English) in width, and the ballasting is composed of sea-shells.

In marshy spots, all the earth-works are laid upon beds of fascines, more or less extensive, according to the nature of the ground. In those situations where the railway traverses pools of water, the fascines alternate with beds of rubble, and are held together by stakes and wattles, until the weight of the earth is laid upon them and the mass is consolidated. The earth-work is chiefly composed of sand from the sea beach, and is covered with turf.

The station at the Amsterdam terminus, is a semi-circular building of brick and cut stone, with projecting wings and sheds on iron columns, founded on piles in the usual Dutch manner.

The station at the Haarlem terminus is also of brick and stone, but is not founded on piles as the ground was sufficiently solid to bear a building.

The Leyden station, which is of the same construction as the others, stands on such bad ground, that it was necessary to construct a raft, placed upon oak piles, to receive the foundation of the building.

The station of the Hague resembles the others, but being constructed on good ground, piles were not necessary.

The bridge over the Spaarne at Haarlem consists of six arches of 8 metres (= 26 feet 3 inches English) span each; four of them are fixed, and the other two are occupied by a cast iron swing-bridge, which generally remains open for the convenience of the navigation, and is only closed at the times of the passage of the trains. The machinery for turning this bridge, and for simultaneously opening or shutting both arches, is situated on the centre pier, which is constructed, like the others, of brick and cut stone, upon piles of pine. A self-acting signal is attached to this, and to all the other swing bridges, in order to show their position.

The bridge-keepers reside in two small wooden lodges, built in the river, opposite to each end of the centre pier. The bridge being equally balanced upon the pivot, the labour of working it is small, as compared with that required for working a half-arch swivel-bridge; and it possesses the far more important advantage of perfect stability and freedom from vibration, when once fixed between its bearings—an indispensable condition for a railway bridge.

The foundation piles of the piers are from 8 inches to 11 inches square and 26 feet 3 inches long. On these piles are laid the longitudinal beams of a timber apron, which traverses the whole of the

openings, and extends above and below the bridge, to the extremities of the cut-waters, and on these are placed the transverse bearers of the piers. The whole of the foundation is of white deal.

The following are the principal dimensions :—

	Ft.	In.	
Thickness of the centre pier,	21	10	Eng.
“ “ piers nearest to the centre on each side,	7	4	“
“ “ “ “ “ abutments,	6	6	“
Length of the iron swivel-bridge,	77	6	“
Width of ditto,	20	10	“
Length of the middle girder,	77	6	“
“ “ intermediate pair,	76	6	“
“ “ outside pair,	74	9	“
Depth of the girders at the centre,	4	0	“
“ “ “ “ ends,	1	0	“
Thickness of the three middle girders,	0	2 $\frac{3}{8}$	“
“ “ outside pair,	0	1 $\frac{1}{2}$	“
“ “ oak planking of the platform,	0	3	“

The castings were made at the foundry of Messrs. Dixon & Co., at Amsterdam.

The cost of the bridge was 83,000 florins (= £6916 13s. 4d.) All the details of dimensions and cost are given.

The timber bridge at Vogelenzang is built on the American trellis-work system; it is 54 metres (= 177 feet 2 inches English) long by 9.92 metres (= 32 feet 6 inches English) wide, and spans the high road and the canal, with its towing path, at an angle of 30° with the latter. The piers are of masonry upon piles.

The timber-work consists of three ribs of lattice-work, one on each outer side of the platform and one in the centre, between the two lines of rails. Each series consists of battens of red Riga deal, 3 inches thick and 12 inches wide, crossed at an angle of 45° with the horizon, and therefore at right angles with each other, as shown in the elevation, and well fastened at each crossing, with oak trenails. More than one-third of the depth of the lattices is below the platform; and its general stability is very much increased, and lateral vibration is prevented, by the diagonal trussing shown in the transverse section and plan of the platform. The transverse oak bearers, 10 inches square, on which the planking of the platform is laid, are placed at intervals of about 3 feet, every alternate one being trussed, as shown in the section, and the truss bound together by a pair of iron screw-bolts, 4 feet long, placed between the longitudinal bearers of the rails. The planking of the platform is of white deal, 3 inches thick and 20 inches wide; and, excepting this and the oak bearers of the platform, the whole of the timber-work is of red Riga deal.

The following are the principal dimensions of the parts:—

	Ft.	In.	
Length of the bridge,	177	0	English.
Total width of ditto,	32	6	“
Width of side openings,	29	0	“
“ middle opening,	111	6	“

	Ft.	In.	English.
Height of the platform,	15	9	
“ “ lattice above ditto,	7	10	“
Depth of the lattice below ditto,	5	2	“
Total height of the lattice ribs,	13	0	“
Clear width of each roadway,	13	0	“

This construction is stated to be very satisfactory, and to have cost only 46,000 florins (= £3832 6s. 8d.)

The trussed timber bridge over the Warmonder Leede, crosses the river at an angle of 50°. It has five openings of 6.30 metres (= 20 feet 8 inches English) each; through one of these, the navigation is carried on, and it is closed when the trains pass, by a sliding platform moving diagonally upon rollers, which is worked by one man, and by very simple mechanism, like that of the double platform bridge at Vink.

The heads of the piles for this bridge require to be cut off, and a tenon to be worked upon each, below the water line; this was done by a simple apparatus, consisting of a deal box, well put together and caulked, so as to be water tight; it was 2 metres (= 6 feet 6 inches English) long, 1.30 metre (= 4 feet 3 inches English) wide, and 1 metre (= 3 feet 3 inches English) deep. Through the centre of the bottom there was a hole large enough to admit the head of a pile. Around this hole was nailed the open bottom of a sack of stout canvas, strengthened with leather. Two cords were made fast, by one end of each, to the box, and the others were passed through pulleys in the sides.

When a pile was required to be cut off, the box was put over it, and by weights within, it was caused to descend as low as was requisite; by means of the two cords, the lower end of the sack was then drawn round the pile, so as to form a water-tight joint; by a small pump, the water was then emptied from the box, into which a workman descended, turned back the canvas sack, and after sawing off the pile, cut the head into any desired form.

This system is stated to have been used wherever the piles were required to be cut off under water, and to have been very successful.

The cost of the bridge over the Warmonder Leede was 44,600 florins (= £3716 13s. 4d.)

The trussed timber bridge, which crosses the canal and the towing path near Leyden, at an angle of 60°, is fixed, and has a span of 17.20 metres (= 36 feet 5 inches English.) Its cost, with some accessory works, was 34,800 florins (= £2900.)

The trussed timber bridge over the Rhine, near Vink, beyond Leyden is at an angle of 82° with the stream; it has five arches, three of which have openings of 10 metres (= 32 feet 10 inches English) each, and the two side arches are 6 metres (= 19 feet 8 inches English) each; one of these latter, which is intended for the navigation, is closed by two parallel platforms which slide diagonally in opposite directions; when opening, they are moved simultaneously by one man, with very simple machinery. The cost of this bridge was 41,200 florins (= £3433 6s. 8d.)

The single swivel bridge over the Delft canal at the Hague, is of cast iron, and spans the canal at the angle of  $72^\circ$ , with only one opening of 8 metres (= 26 feet 3 inches English.) The piers are of masonry, founded on piles. Its cost was 31,000 florins (£2583.)

The railway necessarily passes over numerous canals, whose traffic must be provided for; it was consequently requisite to provide a cheap and simple mode of crossing them; the author therefore devised a peculiar form of bridge, and has called it the "turn rail bridge."

Four timber bearers, 12 inches deep by six inches wide, carry the two lines of rails; they are jointed on to heel posts of oak, shod with iron, which turn upon centres, on plates set in the masonry of the abutment. The bearers are further supported by brackets of cast iron; and each pair is connected by two bars, turning on joints, to preserve the parallelism of the rails. Each pair opens outwards, for the passage of the boats; and when they are closed, the ends of the bearers rest in recesses, prepared in the masonry for their reception, in order that the ends of the movable rails shall coincide with those of the fixed ones. This form of bridge is very cheap, and is found to answer well for a span not exceeding 16 feet.

The population of the towns through which the railway passes, is stated thus:

Amsterdam	.	.	.	.	.	213,349 inhabitants.
Haarlem	.	.	.	.	.	24,012 "
Leyden	.	.	.	.	.	37,464 "
The Hague	.	.	.	.	.	63,556 "
Delft	.	.	.	.	.	17,037 "
Scheidam	.	.	.	.	.	12,051 "
Rotterdam	.	.	.	.	.	78,098 "
Total	.	.	.	.	.	443,567 "

A tabular statement is given of the number of travelers, and the amount of the receipts since the opening of the railway.

Years.	Travelers.	Receipts.						
		Florins	Cts.	£	s.	d.		
1839	77,763	41,765	19 =	3,430	8	7 $\frac{3}{4}$	1st division opened September 20th, 1839.	
1840	319,994	163,333	30 =	14,069	8	10	1st division alone worked.	
1841	292,556	136,693	61 =	11,399	17	8	Ditto. ditto.	
1842	364,081	210,574	34 =	16,714	10	6 $\frac{3}{4}$	2d divis'n opened to Veenenberg June 20th, and to Leyden Aug. 17th.	
1843	466,493	335,893	50 =	27,991	10	6	3d division opened to Voorschoten May 1st, and to the Hague Dec. 7th.	
	1,550,892	893,770	34 =	73,655	16	2 $\frac{1}{2}$		

There is also a statement of the number of locomotives employed, their power, sizes, and number of wheels, the makers' names, the number of miles run over, with many other particulars.

A detailed statement is also given of the lengths and height, above the datum line (AP)\* of every portion of the three divisions of the railway which are opened, with particulars of all the bridges and other constructions.

This communication is illustrated by a section and plan of the line of railway; a map of part of Holland; and one of the city of Amsterdam; also, a series of lithographic drawings of the bridges and other works on the line; and a model of the turn-rail bridges, to be seen in the society's library.

In a letter to the Secretary Inst. C. E., dated May 4, 1844, Mr. Conrad says: "At the last meeting of the shareholders, on the 26th April, we were authorized to borrow 2,500,000 florins (= £211,750) for finishing the fourth division of the railway, or that part between the Hague and Rotterdam. I shall therefore commence immediately the execution of the works, the plans for which I have already laid down. We expect that a new law of expropriation will be passed, and when the States General have conferred upon us that benefit, we shall see the works carried on with increased vigor.

"Since the opening of the railway, as far as the Hague, the improvement in the value of the shares has been very great; the price in December, 1843, was 56 florins, and is now from 98 florins to 99 florins; and the shares will speedily be at a premium.

"The comparison of the number of travelers and of the amount of receipts in similar months of 1843 and 1844, is curious.

	1843.		1844.	
	Travelers.	Florins.	Travelers.	Florins.
January . . . . .	17,439	12,929	35,213	30,968
February . . . . .	18,912	14,276	34,203	29,345
March . . . . .	21,965	16,589	39,498	36,040
April . . . . .	27,329	20,503	51,698	47,651

"The tariff of fares is also altered to the following rate:—  
d.

First class, 5 cents per kilometre per passenger = 1.66 per mile.

Second " 4 " " = 1.33 "

Third " 2½ " " = 0.83 "

This alteration has been found very profitable, as a greater number of passengers now travel in the first class carriages."

Trans. Inst. Civ. Eng'rs.—London Jour. Arts and Sci.

\* AP. (Amsterdam Pile,) a fixed water level adopted by the Government as a datum line in all the hydraulic works in Holland.

*The Hungerford Suspension Bridge.*

This bridge was opened as a public thoroughfare across the Thames, from Hungerford market to Lambeth, on the 1st of May. The following particulars of the bridge, are from a lecture at the Royal Institution, delivered by Mr. Cowper in April. We extract from the *Athenæum*. This bridge is for foot passengers only: it consists of four broad chains, viz., two chains, one above the other, on each side of the platform; each chain consists of ten and eleven links alternately, and, near the piers, of eleven and twelve. This increased strength is to meet the increased strain which takes place near the piers. The chain of the Menai Bridge is only five links wide, and the chain of the Hammersmith only six links wide; but the great breadth of the Hungerford chain (viz., eleven links, or about two feet,) gives them great power to resist the effects of the wind, and thus to prevent vibration. Two brick piers, in the Italian style, are built in the river, over which the chains are carried, forming thus a central and two side spans.

The two piers are in height, . . . . . 80 feet.

The central span between the piers, (being 110 feet wider than the Menai Bridge,) . . . . . 676½ feet.

The length between the abutments, . . . . . 1352½ feet.

Deflection of the chain, . . . . . 50 feet.

Length of each link, (7 in. wide, 1 in. thick,) . . . . . 24 feet.

Weight of each link, . . . . . 5½ cwt.

(The connecting pins are 4½ inches diameter.)

The whole number of links, . . . . . 2600

Their weight, . . . . . 715 tons.

Width of the platform, . . . . . 14 feet.

Height above high water at the centre of centre span, 32½ feet.

— near the piers, . . . . . 28½ feet.

(Giving a rise of four feet in the centre. This gives additional height for the river traffic, and produces a graceful curve, and prevents any appearance of swagging.)

The section of the chains at the centre of centre span is 296 sq. in.

— near the piers, . . . . . 312 sq. in.

A square inch of iron *breaks* with 27 or 29 tons, but 17½ tons is taken as the *impairing* weight, *i. e.* the weight at which it begins to stretch; we have, therefore, for the weight the bridge will actually bear,—

$$296 \times 17\frac{1}{2} \text{ tons} = 5180 \text{ tons,}$$

$$\text{while } 296 \times 5 \text{ tons} = 1480 \text{ tons,}$$

is the greatest load that can be put upon it. This is taking a crowd standing close together to be 1000lb. per square foot. The entire weight of the chain, the platform, and a full load upon it, would make a load of about 1000 tons on each pier, being about 8½ tons on each square foot of brick-work, or not quite 1¼ cwt. on each square inch. The chains are attached to large wrought-iron vertical plates

at the summits of the piers: these plates are firmly bolted together, and also to a strong horizontal plate,—the whole forming what is called a saddle. The saddle is not fixed to the pier, but rests on fifty friction rollers, these resting on a thick iron plate, which is supported by a solid mass of iron and timber girders. The pier itself, being pierced with arches, may be considered to consist of four columns of brickwork; the girders, therefore, are so arranged that no weight is thrown on the *arches*, the whole weight resting on the columns. The saddle is capable of moving eighteen inches each way, equal to three feet entire motion; so that if either span were crowded, the chains would adjust themselves, and the strain be still perpendicular on the piers, and have no tendency to pull the pier over. The method of putting up the chains was thus:—Two sets of *wire* ropes, each consisting of three ropes, were hung from abutment to abutment over the piers, in the exact situation the chains were to occupy,—these *scaffold* ropes, as they may be called, being distant from each other equal to the length of the connecting pin. A few feet above the scaffold ropes, two other ropes were hung in like manner; on these traversed two light boxes, very much resembling a carpenter's bench turned topsy-turvy. These *cradles*, as they are called, were connected together, and contained two windlasses, like those over a common well; these cradles held the workmen. A barge containing the links was moored under the cradles; four men in the cradles hauled up a link; and when they had raised it above the scaffold ropes, the connecting pin was put through, and the pin being allowed to rest on the scaffold ropes, of course supported the link. The cradles were then moved forward, and two links joined to the single link, then one joined to the two; the chain consisting thus, in the first instance, of alternately two and one links. When this two-and-one-link chain was completed, the scaffold ropes were not required, the two-and-one-link chain forming, as it were, a scaffold for the rest of the links; and thus was this bridge erected *without any scaffolding* but these few ropes, and without the slightest impediment to the navigation, and without a single accident. The cost was—

Brick work,	£63,000, by Mr. Chadwick.
Iron work,	17,000, by Sandys, Carne & Vivian.

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£80,000

The money was raised by—

3200 Shares of £25	.	£80,000
By Loan,	.	26,000

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£106,000

Engineer in chief—Sir I. K. Brunel.	Resident Engineer—Mr. P. Pritchard Baly.
	Glasgow Prac. Mec. and Eng. Mag.

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*On the Peculiar Features of the Atmospheric System.*

A paper was read by Mr. Berkeley, which consisted of a series of questions on the “peculiar features of the Atmospheric System,” and

had for its object to elicit opinions upon the comparative practical advantages and disadvantages of the atmospheric and locomotive systems. The chief points which were raised consisted of the mechanical difficulties in the application of the atmospheric system to level crossings and sidings, and the performing the work at the stations, &c., which, in spite of the ingenious device of the engineers who had adopted the system, appeared to entail cost and complexity. The advantages and economy of frequent trains on short lines were admitted, but it was stated that the same plan could be practised with locomotives without any disadvantage. For a long line, the benefit of the plan was questioned. It was shown that greater safety did not exist even on single lines, when the circumstances were equal, and the electric telegraph applied to each; in fact, that when the whole position was considered, the balance of advantage of probable freedom from accident, would appear to be somewhat in favor of the locomotive system: that greater speed had not been usually attained, or that if attained it must involve "inordinate cost." The facility for surmounting steeper gradients was questioned, and the inference drawn, that the enormous first cost would confine the application of the atmospheric system to the same narrow limits as were occupied by other stationary systems; and that it must be classed with them only as a means of overcoming lengths of such bad gradients, as did not come within the limits of locomotive power, or where the lines were short and the traffic was great, terminal and simple. In adverting to the cost of maintenance, the comparative advantages of the two systems were examined, and it was argued, that it was fallacious to compare the expense of keeping up the Dalkey line, which was excavated in rock, and resembled "an uncovered stone drain," with that of maintaining the Dublin and Kingstown Railway, which was a sea embankment, stretching across a part of the bay, and on which the trains were not unfrequently stopped by the waves. An examination was entered into, of the difficulty of removing the earth from slips, or doing any of the usual quantity of contractor's work on the line, without having recourse to locomotives; on this point, the observation of Mons. Legrand, the French Minister of Public Works, might be quoted. On his return from inspecting the Dalkey Railway, he said that there could not be any doubt of the applicability of the atmospheric system to some positions, and probably with advantage, "mais après tout il fallait avouer ce n'était pas un cheval à la main, comme la machine locomotive." In the discussion which ensued, the theory propounded by Dr. Robinson in his recent examination before the Parliamentary Atmospheric Railway Committee, that "a steady uniform height of barometer had nothing to say to the velocity," or did not indicate, as Mr. Stephenson had stated, in his report, "a maximum uniform velocity," was examined, and it was admitted that the case which he proposed in illustration of his theory, was practically impossible, and was irrelevant to the subject. The supposition of the existence of a perfect vacuum in front of the piston, would throw aside the question of the uniform action of the machinery, with an accelerating motion of the train, which, it was

shown, must produce an unsteady height of the barometer; the condition of a steady height could not exist, unless both the power of the resistance due to the velocity, were either equally irregular or regular; in either case an exact balance being maintained. In Mr. Stephenson's experiments, the circumstances of regular power and steady height of the barometer, were shown to exist simultaneously, and the inevitable inference was that a regular uniform maximum velocity was obtained. Dr. Robinson's case was allowed "to have been stated only for the sake of argument," but a practical inconsistency in Mr. Stephenson's experiments of a steady height of barometer with a slight accelerating velocity, was put forward as condemnatory of his report, on the supposition that it was more practicable to note the velocity than to observe the indication of the barometer, and that the true reason for this slight acceleration, was the shortness of the line, and that hence no accurate result could be arrived at.

The question of the loss arising from the evolution of caloric in the air pump, due to the condensation of the air from its rarified condition in the tube to the density of the atmosphere, was considered, and was admitted to be at least as great as had been stated by Mr. Bergin.—*Proc. Inst. Civ. Eng.* Athenæum.

### *Roman Tunnel at Marseilles.*

In your number of February 8th, there was a short notice from the French papers of a very curious tunnel, supposed to be of Roman construction, which had recently been discovered under the mouth of the harbor at Marseilles, connecting the two forts of St. Jean and St. Nicholas. I have just returned from Marseilles, and while there made inquiry for the tunnel, and was assured that they had first heard of such a structure from the Paris papers. This is not the first time, either, that such a report has been spread. There appears to be some tradition that such a thing does exist, but no discovery of the kind has yet been made.

I am, &c.,

PHILIP N. BROCKEDON.

*April 14, 1845.*

Athenæum.

### *Report of the Engineer in Chief of the Georgia Railroad and Banking Company, to the Stockholders in Convention, May 17th, 1845.*

Engineer's Department, Geo. R. R. & Banking Co., 2  
Augusta, May 1st, 1845. 3

TO THE HON. JNO. P. KING, President:

Sir:—Since the date of my last annual report, our road has been extended to Covington, twenty-six miles west of its former terminus at Madison. During the same period, the graduation and bridging upon the whole line, with some immaterial exceptions, have been completed.

The wood work of the superstructure will be laid in a few days, continuously to the Little Stone Mountain, 17 miles above Covington,

and the iron (which has been delayed by the Yellow River Bridge) to a point some six miles beyond the river. To get thus far, we have had to require the iron to be wagoned across the river, at the expense of the bridge contractor. Within a week, however, the bridge will be finished so as to pass the trains, and there will then be no farther interruption to a rapid continuation of the work to its final terminus.

The following statement will show the amount expended on account of the extension of the road, up to this date :

For Graduation and Culverts, - - - -	\$ 264,708 95
“ Bridging, - - - - -	48,559 42
“ Superstructure, (including duty on iron,) - - - -	366,744 07
“ Right of way, - - - - -	17,147 84
“ Real Estate, - - - - -	10,431 53
“ Engineering, Depots, Wells, Divis. Houses, &c., - - - -	24,259 30
	<hr/>
	731,851 11
Estimated cost of road, including duty, - - -	894,000 00
	<hr/>

Leaving to be expended, - - -	\$ 162,148 89
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Which amount will be sufficient to meet all further demands for construction of road, depots, &c., extend the warehouse at Augusta, and supply such *additional* machinery as may be required for the road this year.

Notwithstanding the interruption to the progress of the work, from the magnitude of some of the bridges, and the almost impenetrable character of many of the rock excavations, I have every confidence that the entire road will be ready for use by the time reported to the last annual convention of stockholders. In connection with the Western and Atlantic Railroad, (which will be finished to the Oostenaula about the same time,) we shall then have a continuous line of railway from Augusta, of 250 miles—nearly double the length of our main line in use at the present time.

The extension of the Western and Atlantic Railroad beyond the Oostenaula is, for the present, suspended, in consequence of the absorption of the state appropriation upon the road below it. It seems to me, however, that its early continuation to the Tennessee, appeals to too many of the incentives that control the actions of individuals and communities, to permit a long time to elapse before the work shall be again resumed. Without this extension to the navigable waters of the West, the state cannot expect to receive a remunerating traffic upon her road. With it, she will not only add greatly to the revenues of her work, but elevate its character, from a mere local improvement, to that of a national thoroughfare, connecting the “fertile West” with all the important markets on the Southern Atlantic slope. The completion of the road to Chattanooga, will also place the Tennessee River in the same commanding position, as an avenue of trade between the West and the Southern Atlantic States, that the Ohio now holds to the northern and middle states, and it will present

equal claims upon the general government for appropriations, to render it navigable for steamboats at all seasons, which it is understood can be effected at a much less cost than upon the Ohio.

The importance of the early completion of the improvements referred to above, to the prosperity of our enterprise, are too well known and appreciated by our stockholders to have required any notice of them in this report. But as public attention has been called to another route, to accomplish the same object, terminating on the Tennessee lower down, which may divide the friends of the work, and, consequently, delay its execution, I have thought it proper to present a few remarks on this subject, which, it appears to me, is so deeply interesting to us, both as citizens of the state and stockholders in our road.

While I am inclined to admit, that a route terminating on the Tennessee, at Gunter's landing, *would have been* preferable as the original design to that at Chattanooga, I am decidedly of the opinion, in view of the small amount necessary to complete the road as now laid out, and the impossibility of raising the capital required to build it on the route proposed, in a *satisfactory manner*, that it would be both a waste of time and money, to deviate from the present track.

In expressing doubts whether the terminus selected for the state road on the Tennessee, at Chattanooga, was the best that could have been obtained, I am not insensible to the many and strong reasons which influenced its choice, and must confess, that even with all the lights now before me, any preference entertained for the Gunter's landing route, would be surrendered, if the navigation of the river between these points should be perfected. The whole of North Alabama and Tennessee would then be accommodated, and by a short branch to Rome, the rich valley of the Coosa would also be drained.

The business of the road, and the expenses incurred in working it, during the year ending on the 31st of March, are shown in the following summary statement. A statement in detail of the several accounts below, will be found among the accompanying papers.

*Business.*

Passengers up,	\$ 40,234 75	
“ down,	34,017 80	
Freight up,	72,033 21	
“ down,	90,121 67	
United States Mail,	1,960 32	
Extra Trips with passengers, &c.,	33,381 77	
	<hr/>	\$ 271,749 52

*Expenses.*

Conducting Transportation,	\$ 32,280 67
Motive Power,	28,724 13
Maintenance of Way,	45,054 60
Maintenance of Cars,	16,252 38
	<hr/>
	122,311 78

Carried over.

Amounts forward,	\$ 122,311 78	\$ 271,749 52
Deduct estimated actual outlay for transporting 3,300 tons of iron, wooden rails and mud-sills, at \$1 50 per ton,	5,100 00	
		<hr/> 117,211 78

Leaving nett profits, \$154,537 74

The expenses of the road, as anticipated, are greater than they were last year, in consequence of higher wages paid for labor, and the increased business of the road, together with the necessity of substituting larger axles for many of those first put under the cars. The excess of down freight over the up, compared with the previous year, has also added to the expenses a greater per centage than to the receipts. The difference, however, is only 3 per cent. The expenses last year being 40 per cent of the receipts, and this year 43 per cent.

If we take the number of miles run by the trains to perform the year's business, the comparison shows favorably with any previous period. The following statement gives it for the last two years :

		1844.	1845.
Conducting Transportation per mile run,	cents,	17.50	16.50
Motive Power,	" " "	16 80	14.70
Maintenance of Cars,	" " "	06 75	08.25
Maintenance of Way,	" " "	25.	23.
Total,	"	<hr/> 66.05	<hr/> 62.45

The transportation on the road, including iron and lumber for the extension, and exclusive of materials for repairs of road, &c., is equal to 2,352,896 tons carried one mile. Exclusive of materials for the extension, it is 2,022,896 tons; which gives the cost of transportation, dividing the expenses between the passenger and freight trains according to the distance run by each, on the main line, and calling the Athens train a freight train, three and one-quarter cents per ton per mile. The cost of transporting passengers (making due allowance for the mails) is two and one-third cents per passenger per mile. The cost of transportation, per ton and per passenger, here given as the deduction from our past year's business, is not to be taken as a criterion of the cost of carriage on railroads. This is mainly dependant upon the amount and character of the business done; and without a knowledge of these facts, no comparison can be made with other works. With double the amount of freight, our expenses would probably not have exceeded two cents per ton per mile; and if it had been received in such quantities as to have ensured loaded trains each way, one and one-half cents per ton would have covered expenses.

The cost of keeping up the road, estimating the average length of road in use during the year, at 155 miles, is \$290.60 per mile. Last year it was \$260 per mile for 147½ miles then in operation. The length of road now in use, including 43 miles of branches, is 173½ miles. When the entire line is completed it will be 214½ miles. The cost of keeping up the road for the last two years, is below what we

may expect as an average rate. But I do not believe that it will, at any time, exceed \$350 per mile, unless occasioned by some extraordinary casualties, or the necessity of greatly increasing the speed of our trains, when it will be important to keep the track in more perfect adjustment.

The charges upon the books of the Bank, against the business of the road, up to this date, May 1, 1845, are \$ 179,612 23

The actual expenses, (including the transportation of iron,) are 122,311 78

Leaving, \$ 57,300 45

Which is accounted for by materials furnished and work done for the road, at the shops, as follows:

Cars built previously to April 1st, 1844, and not charged,	\$ 4,691 99
34 Burden Cars built since April 1st, 1844,	17,750 00
Extension of Machine Shop 70 feet,	1,158 30
Extension of road—Alcovy Bridge,	3,567 31
Wood's Mill Bridge,	739 15
Bolts, Spikes, &c.,	961 26
Superstructure,	244 31
Materials on hand, for repairs of road and for car and engine work, at shops, purchased since April 1st, 1844,	24,900 29
Disbursements to date, on account of business of 1845 and '46	3,287 84

Amount as above, \$ 57,300 45

The unusually large amount of materials on hand, consists in a great measure of car wheels and bar and pig iron, which was purchased in view of an anticipated rise in these items, and which could not now be replaced without an additional outlay of several thousand dollars.

The stock of cars on the road on the 1st of April, 1844, was, 6 passenger cars, 47 close, and 41 open burden cars. We now have the same number of passenger cars, 66 close, and 56 open burden cars. Orders have been given to construct two more passenger and 50 close burden cars, to be ready for the opening of the business upon the Western and Atlantic Railroad. This number will be further increased with the demands for their use.

We have also ordered two additional freight locomotives to be delivered during the ensuing summer. These will increase the number of our engines to fourteen, which we think will be sufficient to do the next winter's business.

The business of the road has exceeded that of last year, \$23,653 08, of which the increase on up freight is \$2,372 02; on down freight, \$11,721 41; on passengers, \$6,749 33, and mails, \$2,810 32. From this exhibit it will be perceived that, notwithstanding many of our old customers have been attracted to new channels of transportation, we have been steadily drawing from other sections of the country a trade that has more than compensated for their loss. We should not, however, rest satisfied without making some efforts to remove or modify the difficulties which have caused in many instances a diversion of our trade. These difficulties arise mainly from the imperfect

connexion between the eastern terminus of our road and the sea board. Upon the Charleston route, the drayage at both ends of their road is excessive, but particularly so at this end; and from the circumstance that it comes immediately under the notice of the interior merchants, who frequently remain in Augusta to forward their goods, is particularly objectionable to them.

Whether any modification of the present system can be brought about, I am unable to state; but it seems to me incumbent upon our company, either to make some efforts to modify the objections complained of, or endeavor to make an arrangement which will insure a more perfect communication between this city and Savannah. The transportation upon the river is now not only dependant upon the stage of the water, but the freight lists of the Steamboat Companies exhibit rates for heavy articles—especially on those of little value—which, when compared with similar charges on rivers whose navigation is not more perfect than that of the Savannah, may be considered extravagant.

Upon the Ohio river, between Pittsburg and Cincinnati, a distance three times further than from Augusta to Savannah, the rates are only one-half of those on the Savannah, or one-sixth of them per 100 lbs. per mile.

Upon the Alabama river, the rates of freight are also greatly below those of the Savannah. But the chief difficulty on our river route is, the entire absence of boats calculated to run during the frequent low stages of the water. This difficulty will be considered surprising, when it is recollected that the water on the most difficult bars never, as I am informed, falls below a depth of 20 inches—a point which it reaches only once in a series of years. With this minimum depth of water, I am satisfied from the inquiries that I have made, that produce and merchandize can be transported between Augusta and Savannah at all seasons of the year, provided fair loads can be obtained each way, at a cost of five and a half cents per 100 lbs., including interest on capital, repairs, and depreciation in value of boats. If an average of only half loads, or full loads one way, can be obtained, then nine cents would cover costs, &c., &c.

The importance of this subject to the revenues of our company, will be appreciated by those who witnessed the great loss of freight sustained by the road during last season—amounting, at the lowest estimate I can make, to \$15,000—probably much more.

The adjustment of our rates of freight has heretofore been assigned to the Engineer department; but as the extension of the road has greatly increased the importance and responsibility of this duty, I would respectfully suggest to the Board the propriety of appointing an executive committee to take charge of this subject.

Before another meeting of our stockholders, the enterprise upon which they have been so long engaged, will be brought to a final termination; and I trust that they will then begin to receive an adequate return for their capital invested. The period chosen for the extension of the road could not have been more propitious. Not only have we been enabled to get the work executed upon the most

favorable terms, but a timely order for our iron has given us that item at about \$150,000 less than it can now be bought for.

In closing this communication, I regret to state that the company will shortly lose the efficient services of Mr. Peters, who has been associated with me, either on the construction of the road, or the management of its business, from the commencement of the work. His place at the head of the transportation department will be filled by F. C. Arms, Esq., already favorably known to the stockholders, and who has been for some time fulfilling the duties of the office, under the immediate direction of Mr. Peters.

All of which is respectfully submitted by your ob't serv't,

J. EDGAR THOMSON,  
*Chief Engineer and General Agent.*



*Statement of the Expenses incurred for working the Georgia Railroad, from April 1, 1844, to April 1, 1845.*

**CONDUCTING TRANSPORTATION.**

Stationary and Printing, &c., .....	\$1,735 15	
Loss, Damage, (including \$ 342.42 for stock killed by Trains,) .....	1,004 89	
Incidentals, .....	1,885 25	
Oil and Tallow for Cars, .....	178 38	
Provisions, Clothing, Doctors' Bills, &c., for Negroes, ....	3,244 12	
Expenses of Warrenton Branch, .....	586 32	
Expenses of Horse Car, Athens Branch, .....	1,145 35	
Wages, Laborers and Watchmen, .....	4,317 84	
Agents and Clerks, .....	13,168 56	
Conductors, .....	4,997 81	
Work done by Machine Shops, .....	16 00	
		32,280.67

**MOTIVE POWER.**

Expenses of Water Stations, .....	2,023 57	
Incidentals, .....	210 19	
Wood for Locomotives, .....	7,602 62	
Oil and Tallow for Engines, .....	1,280 42	
Ordinary and extraordinary repairs to Locomotives, .....	5,352 50	
Engineers and Firemen, .....	8,381 35	
Provisions, Clothing, Doctors' Bills, &c., for Negroes, ....	3,348 88	
Work done by Car Factory, .....	524 60	
		28,724.13

**MAINTENANCE OF WAY.**

Mens' Wages, .....	16,381 97	
Supervisors, .....	2,380 00	
Provisions, Clothing, Doctors' Bills, &c., for Negroes, .....	4,154 98	
Incidentals, .....	86 51	
Tools, .....	941 35	
Spikes, .....	2,158 23	
Wooden Rails and Cross Ties, .....	17,475 60	
Work done by Car Factory, .....	537 00	
“ “ “ Machine Shops, .....	943 98	
		45,054.60

**MAINTENANCE OF CARS.**

Rebuilding Passenger Car, Covington, .....	1,600 00	
Repairs of Passenger and Burden Cars, .....	4,952 38	
New Cars in place of others worn out, .....	2,250 00	
Renewal of Wheels and Axles, .....	7,450 00	
		16,252.38

**Total Expenses, .....**

		122,311.78
Deduct estimated actual cost of transporting Lumber and Iron, for 26 miles of extension of Road—equal to 3300 tons a 1.50,		5,100.00
Leaving the Expenses of the regular business of the year, .....		\$117,211.78

## LOCOMOTIVES.

Names of Engines.	Makers' Names and Class.	Commencement of Service.	No. of miles run by each engine from April 1, 1844, to April 1, 1845.	Cost of repairs to each engine, from April 1, 1844, to April 1, 1845.	Total cost of repairs and improvements to each engine, from commencement of service to April 1, 1845.	Total number of miles run by each engine from commencement of service to April 1, 1845.	Condition of Engines.	Remarks.
Georgia, .....	No. 3	May 5, 1837	15995	238 50	5390 94	94070	In House undergoing repairs.	
* Pennsylvania, ..	" 3	" " "	36375	903 50	4833 32	164295	On Road in good order.	Sold to the State of Georgia.
Florida, .....	" 3	Dec. 27, " "	.....	.....	3526 74	60581	.....	
Alabama, .....	" 3	Jan. 12, 1838	38010	639 00	5236 02	141230	On Road in good order.	
Louisiana, .....	" 5	Feb. 2, " "	21120	457 50	6201 80	129690	On Road in complete order.	Altered to Baldwin & Whitney's Patent Freight Engine.
Tennessee, .....	" 2	May 29, " "	14000	321 25	3630 46	76324	In Shops undergoing repairs.	
Wm. Dearing, ..	" 2	Nov. 6, " "	17250	582 00	4376 72	92265	On Road in complete order.	
Virginia, .....	" 2	Dec. 24, " "	12225	340 50	4769 64	71907	On Road in good order.	
Mississippi, .....	" 2	" 28, " "	10635	506 00	3642 77	60407	On Road in good order.	
Kentucky, .....	" 2	M'ch 24, 1839	13875	128 75	4269 22	72241	On Road in complete order.	
Wm. Cumming, ..	" 2	Dec. 14, " "	.....	533 75	1695 08	12575	On Road in complete order.	
James Camak, ..	" 2	" 23, " "	11760	680 75	2661 61	40965	In House in complete order.	Baldwin & Whitney's patent 6 wheel connect. freight engine of 8 tons weight.
Athenian, .....	" 3	Jan. 27, 1845	4110	21 00	21 00	4110	On Road in complete order.	
			195755	\$5352 50	\$50255 22	1,020760		

• The Pennsylvania has run during the three years ending April 1, 1845, 106,915 miles, at a cost for repairs of 1½ cents per mile.

## AMERICAN PATENTS.

*List of American Patents which issued in the month of December, 1844, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For an improvement in the *Bee Hive*; Oliver Reynolds, Webster, Monroe county, N. Y., December 4.

Claim.—“I do not claim constructing the hive of several boxes, placed one above another, with communications between them, and each box having its separate and respective opening; nor the mode of ventilating. But what I do claim as my invention, and which I desire to secure by letters patent, is my manner of freeing the honey boxes from the bees; and, also, of equalizing the hives by the use of the long tube, as set forth.”

This manner consists in employing a long tube, which leads out from the boxes, or hives, through which they can pass out, but will not enter, because of its projection beyond the casing.

2. For an improvement in the *Permutation Lock*, for vaults, doors, &c.; Darius W. Maples, Geneva, Ontario county, N. Y., December 4.

Claim.—“What I claim as new, and desire to secure by letters patent, is the manner herein set forth, in which I have arranged and combined the hollow centres with their wheels and their other appendages, so constructed as to receive the change-pin, through slots, in a plate, and also to receive a set-pin; these pins, and the other parts described, being so arranged as that, by the said combination of parts, the said lock may be set by their means, and by that of the graduations on the escutcheon, and may be locked and unlocked by the application of a compound key, such as is herein described—the lock being operated upon by three sets of motions, as set forth. The combination and arrangement, as a whole, being substantially such as is herein fully made known; not intending, however, to limit myself, by this claim, to the precise number of divisions, or other parts, which govern the extent of the different permutations which may be made by means of a lock constructed upon this principle, but to vary these to any extent which I may deem proper, whilst the arrangement of the instrument is such as to preserve the same principle of action, and the same combination of parts.”

The key, in this case, is composed of a tube turning on a spindle, each being provided with a separate handle, and capable of being connected with the “hollow centres,” that either may be turned at pleasure. The spindle of the key takes into a spindle in the lock, which, by means of levers, operates the bolt of the lock, and on this spindle turns a tube, or “hollow centre,” as it is termed, having a circular plate at the lower end, and on this another tube turns, which has in like manner a circular plate, and so on to any number required.

These plates and tubes are connected together with pins, so that the combination can be varied at pleasure; the outer one of these tubes and the scutcheon plate are graduated to form an index to the permutations. When the wheels are properly situated, relatively to each other and to the bolt, the lock can be opened or closed.

3. For an improvement in *Carding Engines*; Horace Barbour and John Gleason, Lowell, Mass., December 4.

The patentees say—"We make a brush of fine wire, with straight teeth, about one inch long, thick set in leather, like the common card, covering a cylinder as long as the card to be stripped, and about five inches in diameter. Our invention consists in a combination of this brush with the cards of a carding engine, so as to strip the main cylinder, or other cards, while in motion, without stopping them, and without manual labor."

Claim.—"We do not claim attaching or fastening the top cards to the endless chain or belt, and taking them over rollers, or any part of Crane's self-stripping carding machine. What we claim is the combination of this brush with their revolving top cards, (so as to strip them as they pass along,) attached to the endless belt or chain, thereby dispensing with their sweeps, stripping and cleaning cards and cranks. And this combination we claim as an improvement upon their machine."

4. For an improvement in the process of *Treating, Purifying, and Bleaching Oils* and fatty matters, and in making *Soap*; Arthur Dunn, Rotherhithe, Surrey county, Great Britain, December 4.

Claim.—"Having thus described the nature of my invention, and the best means I am acquainted with for performing the same, I would wish it to be understood that I do not claim the apparatus herein described, for forcing streams of air into and through oils and fatty matters—whether purifying, bleaching, or saponifying them—as any suitable apparatus may be employed for that purpose. But what I claim is—1st. The mode of heating, purifying, and bleaching oils and fatty matters, by causing streams of air to be forced, or pressed, into or through them, as herein described. And, 2dly, I claim the mode of manufacturing soap, by causing streams of air to be passed through and amongst oils and fatty matters, when combined or together, with suitable saponifying materials."

5. For an improvement in the *Sofa Bedstead*; Gerard Sickles, assigned to Giles L. F. Griswold, Middletown, Ct., December 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of throwing out the front and back at the same time, by means of levers at or in the ends of the sofa, thereby changing from bedstead to sofa, and *vice versa*, at pleasure."

The front and back are connected together with levers placed in the ends of the sofa, which are hollow for that purpose.

6. For an improvement in the apparatus for *Evaporating Substances to be used in giving Vapor Baths*; Alford C. Haines, M. D., Plattsburgh, Burlington county, N. J., December 4.

Claim.—“What I claim is the mode herein described of constructing my vapor apparatus; that is to say, the water vessel or boiler having a top perforated with numerous small holes, and passing through it a copper coil, and combining with the same the vessel with a perforated bottom for holding the herbs for medicating the bath—the whole being constructed and operating substantially as described.”

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7. For an improvement in the *Washing Machine*; Nathan Parish, Rush, Monroe county, N. Y., December 4.

In this machine the clothes to be washed are put in an endless cloth, and are acted upon by a roller, the whole being placed in a water-tight box.

Claim.—“What I claim as my own invention, and for which I ask an exclusive privilege, is the combination of the fluted roller and revolving endless apron, with the box, or water-tight case, for the purpose of washing clothes.”

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8. For an improvement in *Cooking Stoves*; Adam Ketler, Philadelphia, Pa., December 7.

Claim.—“Having thus fully described the manner in which I construct my cooking stove, what I claim therein as new, and desire to secure by letters patent, is the particular combination and arrangement of parts by which the action and passage of heated air from the fire-chamber to the exit pipe are governed, as herein described—such combination and arrangement consisting in the dividing of the upper horizontal flue above the oven in two unequal parts, one part covering the large portion of the oven—in this part being furnished with a double plate, the direct passage from the fire-chamber being over it, and the other compartment being separated from the oven by a single plate, and admitting the heated air into it through a flue opening at its fore end, and along it to the exit pipe at its rear end; the whole combination being substantially the same with that herein set forth.”

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9. For improvements in the *Machine for Filing Saws*; Calvin B. Rogers, Saybrook, Middlesex county, Ct., December 7.

In this machine there are two files, each attached to a sliding carriage, for the purpose of passing it over the saw, and they are connected with levers so arranged as to lift the files from the saw on the back movement, to permit the saw to be moved, and present the teeth in succession to their action. As the claim refers throughout to the drawings, we are under the necessity of omitting it; but it is limited to the combination and arrangement of the vibrating carriages,

the adjustable files, and the apparatus for lifting them, in order to liberate the saw teeth from their action, as the saw is shifted.

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10. For an improvement in the mode of preparing, applying, and using certain fluxes for the *Reduction of Ores* in the Blast Furnace; Jonas Towers, Madison, Lake county, Ohio, December 7.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the application of those earths or minerals which are dissoluble or diffusible with water, and have an adhesive nature, and can be made into a paste, pap, or grout, with the above or other liquids, and can be applied as other fluxes for the reduction of ores or minerals in the blast or other furnaces. I claim the application of the above preparation, as herein described, to other minerals as well as iron, which have a similar objectional tendency, while smelting, that is found with iron. I do not claim any special right to the use of the above fluxes in a dry or natural state; it is only after they have been mixed or diffused with water or other liquids, and formed into a paste, pap, or grout, and applied as a coating or adhering substance, as herein described, that I claim as my invention, or discovery, and desire to secure by letters patent.”

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11. For an improvement in the manufacture of *Cassimere Hats*; John Maguire, Washington, D. C., December 7.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the making of hats of two distinct and seamless parts, viz: the body and the cover—the whole being manufactured in the manner and for the purpose herein above set forth.”

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12. For an improvement in the *Machine for Cleaning Grain*; Thos. A. Chandler, Rockford, Ill., and Asa D. Reed, Niles, Mich., December 7.

Claim.—“What we claim as our invention, and desire to secure by letters patent, is the manner herein set forth of separating the grain from the straw and chaff by means of a screen constructed with parallel elastic wires fixed at one end, and free to move at their other ends, merely resting upon the frame of the screen—said screen vibrating up and down, by which means the elastic movement of the wires opens the straw, and thus gives full action to the blast.”

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13. For an improvement in the *Furnaces of Steam Boilers, &c.*; Le-man Bradley, Sharon, Litchfield county, Ct., December 12.

This consists in dividing the stack into two, three, or more compartments, by means of partitions extending from the top to a point a little above the entrance of the blast. Into one of these divisions the coal only is put, and the usual charge of ore, coal, &c., in the others; and that part of the hearth which is below the coal division is elevated above the other portion, that the coal may be kept up to the blast,

and permit the melted metal to descend below it. The patentee sums up the operations and the advantages in the following words, viz: "The greatest part of the charge being put in the compartment next to the head-stone, the metal will rest on the boshes, and will not come down faster than it is melted by the blast—the principal part of which comes in through the body of coal in the chamber, from the blow-pipe; the combustion being thereby rendered perfect before the blast reaches the metal, a great saving of fuel is effected, and a better quality of iron is produced. The damper over the coal chamber is kept down during the operation, and the gases are allowed to escape through the chambers on the opposite side of the partition. The fuel in the chamber rests on the hearth, and cannot fall much below the blast. A small blast can also be thrown in on the opposite side of the furnace to the main blast, which is regulated at pleasure."

Claim.—"Having thus fully described my invention, what I claim therein as new, and desire to secure by letters patent, is forcing the air into the fire-chamber in the manner described, above and below the fire, in combination with the method of discharging the products of combustion, as herein set forth, from the fire-chamber. I also claim, in combination with the above, the forcing the products of combustion through a reservoir of water, substantially in the manner and for the purpose above set forth."

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14. For an improvement in the *Apparatus for regulating the Draught of Chimnies*; Joseph Hurd, Stoueham, Middlesex county, Mass., December 12.

The patentee says: "My apparatus, although similar in its principle to the 'Barker's Reaction Mill,' and operating very much like it, is nevertheless applied to the top of a chimney for a different purpose from what the said mill is generally applied—the object of such apparatus being to keep up a steady and regular draught through the chimney, and at the same time prevent the wind from blowing the smoke down the flue."

Claim.—"I shall claim the employment upon a chimney, or discharge flue, in the manner described, of a long tube, having closed ends, and orifices through its opposite sides, at or near its ends, and otherwise arranged and operating as set forth, the same being for the purpose of regulating the draught and facilitating the escape of smoke, as explained."

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15. For an improvement in the *Centrifugal Reaction Water Wheel*; Samuel L. Valentine, Bangor, Penobscot county, Me., Dec. 12.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the water-wheel constructed as herein described, the buckets of which are on a line exactly parallel with the shaft in their cross section, and extend into the centre with flat rings around their periphery, and without any shrouding beyond the outer rings towards the centre—the whole being arranged so that the wheel can be made to run either way, in the manner and for the purposes herein set

forth, combined with the flume on each side thereof, as herein specified."

The reader may imagine this to be a reaction water wheel of the usual construction, with the buckets extended to the shaft, and without a plate on either side of the buckets, so that the water can be applied on both sides, the shaft being horizontal, and the flume so arranged as to conduct the water to both sides. The wheel is provided with rims at the outer extremity of the buckets.

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16. For an improvement in the *Abdominal Supporter*; Calvin Cutler, Springfield, Hampden county, Mass., December 16.

Claim.—"Having thus explained the nature and principles of my invention, it is not my intention to claim generally the use of lateral pads, as heretofore applied, but to claim one or more lateral pads as combined with or used in connexion with the central pad, and in front of the crest of the ilium, for the purpose of producing uniform pressure on the site of the colon and kidneys on the right side, from the capal coli, or head of the colon, to the lower rib of the same side, and upon the left side from the sigmoid flexure of the colon to the lower rib of the same side."

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17. For improvements in *Machinery for Cutting Leather into Soles for Shoes and Boots*; Richard Richards, Lynn, Essex county, Mass., December 16.

The claims in this case refer to, and are wholly dependent on, the drawings, the publication of which, from the numerous sections, would carry us beyond the limits of this work, and therefore we are under the necessity of omitting the claims.

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18. For an improvement in *Saw Mills*; Calvin Stigleman and Austin Seely, Madison county, Ill., December 16.

This saw is to be worked without the usual saw-gate for straining it, this being effected by the elastic force of steam. The two ends of the saw are connected each with a steam piston, the lower one being much larger than the upper one, and the two cylinders in which they work are connected together by a steam pipe, so that the pressure of steam acting on the two pistons strains the saw, and it is carried down to cut by reason of the greater capacity of the lower piston than the upper one.

Claim.—"What we claim as our invention, and desire letters patent for, is the adaptation and application of the upper cylinder in straining and running of saws without a frame, and for all other purposes for which it can be used to advantage, as represented in the drawing herewith transmitted."

19. For an improvement in *Splints for Fractured Limbs*; Lewis Post, Lodi, Seneca county, N. Y., December 16.

Instead of the splint box, or double inclined plane, hinged and provided with screws, as heretofore employed, the present patent is for making of the splints themselves, which are adapted to the form of the limb, the double inclined plane, by uniting with a hinge the extension, thigh, and leg splints.

20. For an improvement in the *Cooking Stove*; Archibald Whiting, Middletown, Dauphin county, Pa., December 16.

We are under the necessity of omitting the claim in this case also, as it refers to, and is wholly dependent on, the drawings. It is limited to an arrangement of the flues and dampers for conducting the draught around the oven back of the fire chambers, and the one which extends under the fire chamber and the back oven.

21. For an improvement in the *Cooking Stove*; Wm. L. Potter, Clifton Park, Saratoga county, N. Y., December 19.

Claim.—“What I claim as my invention is the mode of combining my two ovens and flues, viz: the draught descending at the back of both ovens, under the lower oven, and up in front of the lower oven in one entire sheet, and dividing at the front of the upper part of the lower oven, on either side of the stove, into two flues, the draught under the upper oven being directly from the lower part of the fire chamber through a contracted flue, in the manner and for the purpose described.”

22. For a *Machine for making Wooden Boxes for Match Splints*, &c.; John H. Stevens, New York city, N. Y., December 19.

These boxes are made by cutting out a square groove from a block of wood, by means of two circular saws on one shaft, placed at a distance apart equal to the width of the inside of the intended box, and the wood between them is cut away by rotating cutters, and then by two small circular saws, at right angles to the first; small grooves are cut near the upper edges to receive the cover. The ends are glued in afterwards.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the combination of the cutter and saws, by which the boxes are cut out with the cutters, for making the grooves to receive the lid as described.”

23. For a *Machine for Planing and Dressing the knuckles of Butt Hinges*; Gage Stickney, Blackwoodtown, Camden county, N. J., December 19.

The hinge, opened, is placed on the bed of the machine, with the projection of the knuckle which is to be planed, upwards. Two guide jaws are brought down upon it, one on each side of the knuckle, and kept down by weights, and the hinge is then forced forward against the tool which planes and dresses the knuckle to the form re-

quired—there being guide pieces beyond the cutter, to guide the hinge as it passes under the cutter.

Claim.—“Having thus fully described the nature of my improvements in the machine for planing or dressing the knuckles of butt hinges, and shown the operation of the same, I do hereby declare that I do not claim to be the inventor of either of the individual parts or devices herein described, when taken separately and alone; but what I do claim as constituting my invention, and desire to secure by letters patent, is the particular manner in which I have combined and arranged these parts so as to adapt them to the operation of planing or dressing, as set forth: that is to say, I claim the manner of forming and arranging the guide jaws, so as to press simultaneously on each side of the hinge to be planed, in combination with the follower, the bed, the planing tool, and the guide-pieces which govern the hinge as it is being planed—the whole combination and arrangement being substantially the same with that herein set forth.”

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24. For an improvement in the *Plough*; Anthony Taylor, Greenford, Columbiana county, Ohio, December 19.

The point of the plough is covered by an additional point, made with a socket, to slip on to the usual point. And for the purpose of strengthening the land side, an additional land-bar is put on by bolts, the forward edge being made with a lip and sharp edge, to embrace the share.

Claim.—“What I claim as my invention, and which I desire to secure by letters patent, is the use of the shoe or socket point, made as aforesaid, in combination with the before-described plough. I do not claim an additional or false land bar, but the mode, herein described, of strengthening the share by means of the extra land bar, by which I am enabled in my plough to use wrought-iron shares.”

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25. For an improvement in *Safety Switches for Railroads*; Gustavus A. Nicolls, Reading, Berks county, Pa., December 19.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is a safety turnout switch, embodying the combined use of inclined planes and guides to elevate and slide the wheels on the tracks, and the combination of these planes and guides with the safety bars.”

This improvement, as indicated in the above claim, consists in the employment of two parallel bars attached to, and moving with, the switch; so that, when the switch has been shifted and put in connexion with the turn-out rails, they are in line with the rails of the main track; and, in the event of neglect on the part of the attendant to replace the switch, a car from the main track will run on to these parallel bars, which are, at their fixed end, connected with the main track by means of inclined planes and guides, so arranged as to elevate the flanch of the wheels (which are outside the track) over the rail, and guide the whole of them to the line of the track, and thus prevent the cars from running off.

26. For improvements in *Locomotive Steam Engines*; Edwin F. Johnson, Middletown, Middlesex county, Ct., December 31.

The improvements claimed, and for which letters patent are desired, are the following: 1st. The vibrating cross-head, and mode of attaching the two connecting rods thereto, so as to permit the drawing of driving wheels, to conform to the curvature of the road, without interfering with the movement of the steam-pistons. 2d. The mode of maintaining or preserving the relative motion of the two sets of drawing or driving wheels, by the combination of the horizontal slide rod, the arms, the crank bars, and the cranks, on the axles of said wheels. 3d. The mode of communicating the motion from the cross-heads to the crank bars, by attaching the connecting rods to the crank bars between the crank pins; also, the mode described and represented of retaining the frustums of cones in their proper position, by means of the vertical bars and horizontal bars. 4th. The mode of giving steadiness and support to the vibrating cross-heads, by combining with them the eccentric cog wheels and rods, as described, and the attaching of one pair of said wheels firmly to the same shaft. 5th. The use and application of the rods and lever, on the two sides of the machine, to conform the drawing or driving wheels to the curvature of the road.

It will be evident to the reader of the above claim, that, without drawings, it would require a very lengthy description to point out clearly the improvements covered by this patent; but the claim is sufficient to enable the engineer to understand the general plan of the inventor.

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27. For improvements in the *Machine for Hulling and Cleaning Clover Seed*; A. B. Crawford, Wooster, Wayne county, Ohio, December 31.

The rubber is composed of two truncated cones, united by their bases, so as to be of greater diameter in the middle than at the two ends. The grain is fed in at the two ends with a current of air, and discharged at the middle. The concave, of course, being of the same form.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is constructing the rubber and concave substantially in the manner set forth; the seed being received in at the two ends, and, together with a current of air, discharged at the centre. I also claim the combination of the screens with the sieve, in the shaking shoe, in the manner and for the purpose set forth, and, in combination therewith, the directing windboards, for the purpose above described.”

The screens are made with slats, like a venetian blind, and the sieve is the usual clover sieve. Windboards are properly arranged to direct the current of air on to the grain.

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28. For an improved mode of feeding and turning the rod in *Nail Cutting Machines*; Caleb Isbister, Allegheny city, Allegheny county, Pa., December 31.

Claim.—“What I claim as my invention, and desire to secure by

letters patent, is the mode of feeding the nail rod, or plate, to the cutters, by means of a rotating hollow shaft, or tube, operating substantially in the manner described, whereby the rod, or plate, is turned over at each operation. I claim, also, the combination of the parts which communicate the progressive feeding motion to the nippers, by the up-and-down movement of the forward end of the rotating hollow shaft, or tube, as described; and I claim the combination of parts by which the nippers are brought back, and the machine stopped. And, finally, I claim the combination of parts by which the motion is communicated from the nail machine to the rotating hollow shaft or tube."

As all who are acquainted with this branch of manufactures know well, one end of the nail is thicker than the other, it becomes necessary to reverse or change the inclination of the rod at each time a nail is cut, to make the head end from opposite sides at each successive operation. By hand the former course is pursued, which prevents the action of the cutters from bending the rod; but by the machines heretofore employed or essayed for this purpose, the inclination only has been changed; and the object of the present improvement is to effect the presentation of the rod in the same manner as by hand, and thus prevent the tendency to bend the rod.

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29. For an improvement in *Propelling Ships*; John Ericsson, New York city, N. Y., December 31.

The propeller, with its hub, is hung to a swinging or sliding frame, by which it can be drawn out of the water, to remove all obstruction to the sailing of the vessel during fair winds; and the shaft is so arranged as to admit of sliding endwise, for the purpose of withdrawing it from, or introducing into, the hub. The rudder is placed abaft the propeller, and arranged with the view of avoiding all interference with this arrangement of the propeller.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the arrangement of the propeller shaft and rudder, in combination with the mode of attaching and detaching the propeller by means of a swinging or sliding frame, in the manner hereinbefore described.”

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30. For an improvement in the *Machine for Planting Seeds*; Wells Kilburn, Lawrenceville, and Frederick Haines, Marietta, Pa., December 31.

In this machine the seed box has two grooves in the bottom, one towards the front, and the other towards the back, extending from side to side; and these communicate with a series of tubes that run down into holes in the cultivator teeth—the tubes of the front groove are between those of the back groove, and over each groove there is a square roller, to regulate the supply of seeds. The cultivator teeth which form the furrows, and through which the seeds are conducted, are hinged each to a beam jointed to the forward part of the frame,

and provided with a roller at the back end, to follow the undulation of the surface, and regulate the depth of the furrow. The cultivator teeth are also connected with the forward part of the frame, by means of chains attached to them below the joint, so that, in case of meeting any serious obstruction, the chains will break, and permit the teeth to pass over unharmed

Claim.—“Having thus fully described our invention and its operation, what we claim therein as new, and desire to secure by letters patent, is the combination of a series of cultivator teeth with the adjusting rollers and frame, as herein described—said teeth being jointed and adjustable, and the whole constructed and arranged substantially in the manner and for the purpose herein set forth.”

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31. For an improvement in the *Horse Power*; Samuel B. Haines, Greensburgh, Westmoreland county, Pa., December 31.

The master wheel in this machine is without a shaft, and is therefore guided by rollers, and the horse levers are attached to flanches on the outer periphery, and to each other, forming a quadrangular frame. The band wheel, with its shaft, is placed within the driving wheel.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the arrangement of the band wheel within the master wheel, as described, in combination with the arrangement of the horse levers around and attached to the periphery of the main driving or master wheel—the whole being substantially as herein above described.”

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32. For an improvement in *Machinery for cutting Screws on the Posts and Rails of Bedsteads*; Wm. F. Converse, Richard H. Penny, and Richard S. Hannaford, Harrison, Hamilton county, Ohio, December 31.

Claim.—“What we claim as our invention, is combining the sockets and cutters for cutting the screws on the rails and in the posts, with the mandrels of a lathe for turning wood, in the manner and for the purpose substantially as described. We also claim attaching the cutters for cutting the screws on the ends of the rails to a socket, which works on a screw or mandrel, so that the length of screw is cut beyond the socket, and thus the necessity of running the threads of the socket into the threads cut is avoided. And, finally, we claim attaching the cutter for cutting the threads in the post, on the outer periphery of a socket having a female screw working on a screw or mandrel, for the purpose fully set forth.”

*List of American Patents which issued in the month of December, 1841, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

(Continued from Page 27.)

12. For improvements in the *Cast-Iron Plough*; Reuben McMillen, Middlebury, Summit county, Ohio, December 14.

Claim.—“I do not claim to be the first who has cast the land side and beam in one piece, this having been previously done, but not in a manner similar to that devised by me. What I claim, therefore, in this part, is the so forming of the beam as to cause it, on its lower side, to rise directly from the forward and lower points of the mould board, and its upper edge to rise directly from the upper and forward end of the said mould board, its lower portion constituting a continuation of the land side, said beam rising thence upward and forward; and in combination therewith, I claim the casting of the share and coulter in one piece, in such a manner as that a V groove on the back edge of the coulter shall be received by a corresponding edge on the front line of the beam or land side, by which means the coulter will be retained in its place, and secured against the action of a blow on the under side of the point or share. I claim, likewise, the particular manner in which I confine the share in place, by means of what I denominate the saddle, and the hooked tenon, or tenons, and the dove-tailed tenon, adapted to the dove-tailed gain, or notch, in the land side, into which it is slipped back, the respective parts being constructed and operating substantially in the manner set forth. I also claim the particular manner in which I secure the mould board to the land side, by means of the hooked piece in combination with the mortise, the share, and the projecting piece on the inner part of the land side, for sustaining the point, or forward end, of the mould board, all as described.”

13. For an improvement in the *Machine for Cleaning Grain*; David Baldwin, Whithall, Washington county, N. Y., December 14.

The grain is acted upon by rotating beaters and segmental buckets, on a vertical shaft, the whole working within a casing. The radial beaters are placed between a series of rings, or “circular plates,” which are connected with the shaft by spiral wings, which produce a current of air through the machine. The beaters do not extend inwards quite so far as the inner periphery of the rings, or circular plates, which are connected together by means of eccentric segment plates, which concentrate the current of air. The number of circular plates may be regulated by the judgment of the constructor: in the drawings, five are represented.

Claim.—“What I claim, is the employment of spiral wings for connecting the circular plates to the hubs and shaft, and compressing the air in the case, in combination with the segment buckets and radiating beaters, as herein set forth.”

14. For an improvement in the mode of *Polishing Daguerreotype and other Plates*; John Johnson, New York city, N. Y., December 14.

This is for an apparatus with which to present plates to a polishing disk on the mandrel of a lathe, the character of which is fully expressed in the following claim: "What I claim, is the polishing of metallic plates for Daguerreotype or other purposes, by means of an instrument such as I have denominated a plate-holder, in combination with a wire or rod, received within a socket, upon which the said plate-holder and the contained plate may revolve, when held against a polishing disk or buff, and by which it may be shifted towards or from the centre of said buff, the whole apparatus being arranged, combined, and operating substantially as herein set forth."

15. For an improvement in the mode of opening and closing *Waste Water Gates*; Robert Robinson, Greece, Monroe county, N. Y., December 14.

The gate (or gates) is provided with a chain which passes over a roller, and is attached to one end of a lever, the other end having a box suspended to it. When the water rises too high, it passes over a dam, and fills the box, which, by its preponderance, sinks, and opens the gate; and the box being provided with small holes, after the water has ceased to flow over the dam, it runs out of the box, and thus gives the preponderance to the gate, which is then closed by the pressure of the water.

Claim.—"What I claim as my invention, is the method of opening and closing the gates, by the combination of the gates and box attached to the lever, for the purpose described."

16. For an improvement in the *Hydraulic Gate*, for Locks, Docks, &c.; Geo. Heath, Little Falls, Herkimer county, N. Y.—anti-dated July 3d, 1841.

This improvement consists in using for the gate, singly or in two parts, the segment of a cylinder for the front of the gate, with the radius which cuts the centre line of the arch of the segment lying horizontally, and with the arch next the water which is to be passed. This front of the gate rests for its support against the pressure of the water, on gudgeons at the centre of the cylinders, which are connected with the front, either by arms, or by the sector of a circle, at the two ends of the segment.

Claim.—"What I claim, is making the gates in segments of cylinders, hung upon gudgeons, as described, so that the pressure of the water against the gate shall be borne by gudgeons, instead of the edge of the slide, as in the common sliding gate."

17. For an improvement in the *Furnace for the manufacture of Malleable Iron directly from the Ore*; Claude S. Quillard, Rondout, Ulster county, N. Y., December 23.

Claim.—"I claim the combining of one or more reverberatory fur-

naces with a chimney, or stack, containing in its lower part a deoxidizing furnace, which I have denominated a crucible, in such manner that the said crucible and the contained ore and carbonaceous matter shall be heated by the flame and escape-heat from the reverberatory furnace, or furnaces, by an arrangement and combination of respective parts, substantially the same with that herein made known. Secondly. I claim the manner of agglutinating the mass of deoxidized iron, previously heated in the reverberatory furnace, by submitting the same to pressure within a cylinder, or other formed receiver of any suitable construction, by means of a screw lever, or other press, preparatory to its being acted upon by the hammer, or by rollers. I am aware that puddle balls, or loops, have been squeezed, and worked, by means of a vibrating lever, upon a flat table; but this is an operation which could not be applied to the iron as prepared by me, as, instead of agglutinating, it would separate its particles—its pressure in a contained vessel being an essential part of my process.”

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18. For an improvement in *Pneumatic Springs*, for Railroad Cars and other purposes; Alex. Connison, Belleville, Essex county, N. J., December 23.

The claim in this patent refers to the drawings, and we are, therefore, under the necessity of omitting it; but it is limited to the combination of a hollow piston rod, having an enlargement within the cylinder, which constitutes one of the piston heads, with the piston, the under face of which is a hemispherical cup, and hemispherical leathers fitting therein, and a bolt, the head of which fits into the leather cups, and passes up through the hollow piston rod, so that by a screw nut on the outer end, the cup-formed leather packing can be regulated at pleasure.”

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19. For a mode of *Propelling a Locomotive by Stationary Machinery*; John A. Etzler, Philadelphia, Pa., December 23.

The claims in this, as in the preceding, we are under the necessity of omitting, because they refer to, and are dependent on, the drawings; but the first section is limited to the method of communicating motion to a locomotive carriage from stationary machinery, by combining a double crank on one shaft, and at right angles with two bands, or chains, extending from the cranks, passing around a horizontal wheel, and thence extending to the two ends of a lever, which is thus vibrated by the rotation of the cranks—the vibration of the lever sets in motion a set of hands that actuate ratchet wheels on the shaft of the driving wheels. The second claim is limited to an arrangement of parts for shifting the relative position of the lever, as the carriage progresses; and the third claim is limited to the arrangement of a lever attached to the back axletree for guiding the locomotive.

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20. For an improvement in the *Portable Counter Balance*; Albert Dole, Bangor, Penobscot county, Me., December 23.

Claim.—“I claim the combining a steel-yard beam and parallel

frame, arranged and supported as set forth, with the cradles constructed and operated as described, said cradle being provided with appropriate hods, and the whole being arranged and acting in the manner specified, so as to enable me, by the use of a single pea, to weigh pounds in the large hod, and ounces in the small one."

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21. For an improvement in the *Tobacco Press*; Joseph Bucey, Wes River, Ann Arundel county, Md., December 23d.

This is for an improvement in the Screw Press. The follower is permanently attached to the end of the screw, so that instead of turning the screw, it is carried up and down by turning the nut, and the improvement consists in connecting the nut with the cap-piece of the press, by means of a metallic box bolted to the cap-piece, and embracing the nut.

Claim.—"I claim the manner of forming and combining the nut and metallic box, as set forth, in conjunction with the combining them with the head block, or cap-piece, by means of which arrangement the press can be conveniently worked by horse power, whilst the head block of wood is left of such strength as to render it perfectly efficient."

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22. For an improvement in the *Wrought Iron Plough*; Marshal Mims and Seaborn J. Mims, Starkville, Oktibbeha county, Miss., December 23d.

The standard, or helve, of this plough, is attached to the beam by a single bolt at the top, and a diagonal brace, provided with several bolt holes, for the purpose of adjustment. The helve is also adapted to the reception of all kinds of mould boards, shovels, &c.

Claim.—"We claim the particular manner in which we have arranged and combined the helve brace and mould board, so as to adjust the position of the latter by means of the adjustable brace and the bolt, and thus to determine the depth of the furrow, in the manner described, whether applied to a single or a double plough, as set forth. We also claim the adapting to the same plough any of the various kinds of hoes, shovels, or other instruments, analogous in character, and occasionally used in the place of mould boards; such adaptation being effected by means of the adjustable brace and helve herein described."

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## ENGLISH PATENTS.

*Specification of a Patent granted to JAMES FENTON, of Manchester, Engineer, for his invention of an improved combination or alloy, or improved combinations or alloys, of metals, applicable to various purposes for which brass and copper are usually employed, in the construction of machinery.*

This invention of an improved combination or alloy of metals is

intended to be used in the construction of machinery in general, in those places and situations where brass and copper are usually employed. The improved alloy, it is stated, may be beneficially used as a substitute for the ordinary metals, in consequence of its not being liable to heat, or subject to other destructive results, caused by friction and ordinary wear and tear; also, by greatly decreasing the consumption of oil or grease, and being of increased durability, and much lighter weight in the same bulk of metal. All these advantages will be sufficiently evident to the practical engineer and mechanic, as well as the great variety of purposes for which this improved combination or alloy of metals may be employed in the construction of machinery, such as steps, bearings, pedestals, journals, bushes, axle-boxes, connecting-rod ends, cocks, taps, pump-barrels, pump-rams, plungers for buckets, &c., and also as a substitute for the more elementary parts of machinery, (formerly made of brass and copper,) such as rollers, for calico and other printers, bowls, &c.

The manner of carrying this invention into practical effect, is to be according to the following formula:—Firstly, take thirty-two parts of copper, fifteen parts of block tin, and one part of sheet brass, and mix or combine these in the following manner:—The copper being fused, or melted, in a crucible, or other suitable vessel or furnace, the sheet brass is added thereto, and afterwards the block tin is thrown in; the alloy is then poured off in ingots, and a metal is produced, which the patentee terms “hardening metal.” Under this head he claims the novel and peculiar use of these metals, to form “hardening metal;” but the quantities may be varied, to give the alloy any required degree of hardness, or various other metals may be added, in small quantities, to effect the same purpose; he likewise claims the use of these, in connexion with copper and block tin; the above constitutes the first part of the process employed by the patentee in the manufacture of his ultimate alloy or alloys.

Secondly, take two parts of the hardening metal, previously described, nineteen parts of zinc or spelter, (or so many parts of calamine as shall be equal to the quantity of zinc or spelter,) and three parts of block tin, and mix or combine these in the following manner: First, fuse or melt the zinc, spelter, or calamine in a crucible, or other suitable vessel or furnace, which must be sufficiently large to contain, along with the zinc or spelter, the hardening metal previously described, and the block tin last specified. The hardening metal should be fused or melted in a separate crucible, or other suitable vessel or furnace, and then mixed or combined with the zinc, spelter, or calamine; the alloy must be well stirred, with a suitable implement, in order to render the combination of these two metals or semi-metals as complete as possible. The block tin is then added, to give the ultimate alloy or alloys the requisite degree of ductility, or toughness. The whole must be again well stirred with a suitable implement, in order to render the combination of this, the ultimate alloy or alloys, as complete as possible. It may then be cast, or employed in the usual manner, in the various forms required for the construction of machinery. While the zinc or spelter is being melted, the surface of

it should be well covered with a coating of powdered charcoal, in order to prevent the volatilisation of the semi-metal. Under this head the patentee claims:—"The use of these metals and semi-metals, above described, to form my ultimate alloy or alloys; but the proportions may be varied, to suit particular cases, and a variety of other metals may be added in small quantities, the use of which I also claim, though not absolutely requisite to form my ultimate alloy or alloys. I further claim the use of the semi-metal zinc, spelter, or calamine, as the basis of my ultimate alloy; and although I have found the manner of combination above described the most effective in preparing the alloy or alloys which I substitute for brass and copper, in the construction of machinery, I claim the use of the said alloy or alloys, although combined in any other manner or proportions whatever; such combination or alloy being made, either in the exact proportions herein set forth, or in any other, within such limits as are substantially the same, and will produce a like result, as a substitute for brass and copper, to be used in the construction of machinery."

London Min. Jour.

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*Specification of a Patent granted to ROBERT FERGUSON and JOHN CLARK, both of the city of Glasgow, in the county of Lanark, for an improvement in Printing and Calendering.*—[Sealed 14th September, 1844.]

The first part of this invention relates to the cylinders or bowls of calico printing machines, and consists in forming the outer covering or surface of the cylinder in a peculiar manner, whereby the ordinary covering of "lapping" is dispensed with, and the employment of an endless blanket is rendered unnecessary, as the new surface is sufficiently smooth and elastic for obtaining the impression from the printing roller or rollers, whether engraved or cut in relief.

The improved covering or surface is formed in the following manner:—The cylinder, after being well cleaned, is rubbed over with a solution of green senegal, (formed by dissolving eight pounds of the gum in one gallon of water,) and placed in the printing machine, which is to be furnished with a plain copper roller, in place of the ordinary engraved printing roller; a piece of cotton cloth, coated on one side with India-rubber cement, is now placed with its uncoated side next the cylinder, and with a blanket interposed between it and the copper roller; a slight pressure being then put on the machine, one round of the cloth is rolled upon the cylinder, and is carefully cut from the remainder of the piece, so as to make a neat join. The patentees then take a piece of "Clark's patent India-rubber cloth," or a piece of cotton cloth, *mousseline-de-laine*, thin flannel, or fine woollen cloth, coated on one or both sides with India-rubber cement, or "Jeffery's patent marine glue," and, after cutting the end straight, it is laid upon the cylinder; a slight pressure is then put on the machine, (the blanket having been removed,) and from twenty to thirty rounds of cloth are rolled upon the cylinder: the end of each round

is cut correctly opposite the previous end, so as to make a good join. The pressure is increased every five rounds, ending with a pressure similar to that used in printing; and the machine is caused to continue in motion, with this pressure, for half an hour: the attendant keeping the copper roller clean, by rubbing it with a cloth, damped with weak soap-suds, to prevent the India-rubber cement, or marine glue, from adhering to the roller. After this, the outer surface of the cloth is coated with a mixture of India-rubber cement and lamp-black, to the thickness of one-sixteenth of an inch; or the mixture is applied to a piece of "Clark's patent India-rubber cloth," and one round of the cloth is rolled on the cylinder. When the mixture is dry, the elastic surface is cut to the required width, whilst the cylinder is revolving, by means of a chisel upon a rest; and the revolution of the cylinder, in contact with the copper roller, is continued for about an hour. The coating is now "cured," by rubbing over it sulphuric acid, of the usual strength, or muriatic acid, diluted with water to 60° of the Tweeddale hydrometer; this acid is allowed to remain on for about fifteen minutes, (the cylinder continuing to revolve,) and is then washed off with clean water. When in use, the cylinder is kept clean by a roller, covered with sponge or cloth, in a moist state; and the superfluous moisture left by the roller is taken up by a lint or dry doctor.

The following is another mode of producing the elastic surface: After the cylinder has been rubbed over with a solution of gum senegal, as before mentioned, and has received one round of cotton cloth or other material, coated on the outer side with India-rubber cement, a band or fillet of flannel, or other suitable material, (three inches in breadth, and coated on both sides, and at the edges, with India-rubber cement,) is rolled tightly round the cylinder, by commencing at one end and using a plain copper roller, which presses against it, until the band reaches the other end of the cylinder. This wrapping is then coated with a mixture of India-rubber cement and lamp-black, and when dry, the elastic surface is cut at the sides, and cured, as before described.

Another method consists in covering the cylinder with a few rounds of lapping, in the ordinary way, and applying thereto a quantity of Jeffery's marine glue, brought to a liquid state by the application of a heat of from 200° to 300° Fahr.: the cylinder is now ready for use.

A smooth elastic surface is also obtained by "putting together from twenty to thirty plies of Clark's patent water-proof cloth, or other laminæ, coated with India-rubber cement, or Jeffery's patent marine glue, in the manner before described," and making an endless strap or belt thereof, which is caused to embrace the cylinder, and a flanged roller above it, and is moved onward by the rotation of the same.

The second part of this invention consists in applying a smooth and elastic surface, in the manner above described, to the tables of block-printing machines.

The third part consists in producing smooth and elastic surfaces, in the same way, upon the cylinders or rollers of letter-press printing

machines; also in bringing Jeffery's marine glue to a liquid state, by the aid of heat, and casting it into rollers, to be used in letter-press printing.

The last part of the invention consists in the application of a smooth and elastic surface, by the methods above described, to the rollers of calendering machines.

The patentees claim, Firstly,—the application to cylinders, bowls, or rollers, for printing calicoes, of a smooth and elastic surface, in manner herein described; including the belt or strap traveling round the cylinder. Secondly,—the application of an elastic bed or surface for block printing, as above described. Thirdly,—the application of a smooth and elastic surface to rollers and cylinders, and the casting from Jeffery's marine glue of rollers and cylinders for letter-press printing, as above described. Fourthly,—the application of a smooth and elastic surface to rollers or bowls for calendering, as above described.—[*Inrolled February, 1845.*]

Trans. Soc. Arts.

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## MECHANICS, PHYSICS, AND CHEMISTRY.

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*The Progress and Present State of the Daguerreotype Art. By*  
M. CLAUDET.

Continued from page 51.

Nevertheless, the invention of Mr. Woolcott was at the time a great improvement, and deserves to be recorded in the history of the daguerreotype as a very clever and very ingenious arrangement. The effect of the daguerreotype picture is formed by a very slight film similar to the bloom of the grape or the down of the wing of the butterfly, so delicate that it may be wiped off or destroyed by the slightest touch. This fragility induced many persons to endeavor to discover some method of fixing the design. Mr. Dumas, the celebrated chemist, discovered a vegetable varnish which, dissolved in boiling water, could easily be applied to the surface of the picture, and, when dried, was a perfect protection to the image. But it was left to Mr. Fizeau to discover what has proved one of the greatest improvements in the daguerreotype process, and which consists in fixing the delicate image by means of a transparent coating of gold, applied by boiling upon the plate a solution of chloride of gold, which not only renders the image more durable, but has the advantage of increasing the tint, so that a picture fixed by Mr. Fizeau's process is rendered more forcible, and the mirror-like effect is almost destroyed. Some time after Mr. Fizeau had made his discovery, I was fortunate enough to devise a means of increasing the sensitiveness of the prepared tablets. This I accomplished by exposing it, previously coated with iodine, to the vapor of a compound of chlorine and iodine, or chlorine and bromine, which second exposure so modified the chemical coating of the plate, that its sensitiveness was increased to at least fifty or sixty times, and from that moment it became possible to take portraits without difficulty with the ordinary apparatus.

With iodine alone, and a camera furnished with an achromatic object-glass of the shortest focus, it required about five minutes, though, by the simple addition of the vapor of chloride of iodine, I at once obtained the power of operating in as many seconds, and under the most favorable circumstances, in much shorter time; for it has been found possible to reproduce moving objects. In one word, the operation has (by the introduction of this improvement) been literally instantaneous.

Daguerre recommended that the plate should be exposed to the mercury at an angle of forty-five degrees, supposing that the vapor received upon it at that inclination would cause the development of the picture with greater effect. But this operation is equally effective and rapid in any other position, and I have not only succeeded in producing the image in a vertical or horizontal position, but, even when the coppered side of the plate was turned downwards or towards the mercury, I have found the effect to be precisely the same in all these various positions.

I have also ascertained that the mercurial vapor does not enter into combination with the surface of the plate, unless it has previously been exposed to the influence of light. A plate was exposed to the mercury before and after it had been coated with iodine, but the operation in the camera was not affected by this premature exposition of the mercury, so that it is absolutely necessary that the mysterious influence of the light should be exerted upon the plate before any degree of affinity exists between it and the vapor of mercury with which it is brought in contact.

The knowledge of this fact led me to a curious modification of the process of Daguerre.

Having ascertained that the mercury did not injure the sensitiveness of the plate, (before exposure to the light,) it occurred to me that it would be possible to conduct simultaneously the operations of the camera and the mercury-box, which I did by placing in the camera a cup containing mercury previously heated by a spirit-lamp. The plate was thus constantly immersed in the mercurial vapor during the exposure to the image of the camera.

As soon as the light had begun to operate, the vapor of mercury was combining with the iodine of silver, and, by means of a light striking through a piece of yellow glass, I was able to study the progress of the operation. For it is a curious fact, as I shall endeavor to shew presently, that yellow, green, and red rays of light scarcely produced any effect upon the prepared plate of the daguerreotype; and it is still more extraordinary that yellow light operates upon the plate in a manner perfectly analogous to that of mercury in the development of the invisibly impressed image, so that the light admitted into the camera obscura, so far from injuring the operation, was accelerating the development of the image. This effect of the yellow rays was first noticed by Mr. Bequerel, and, from this property, he has called them "continuating rays." Some photogenic paper had been exposed to light in a camera, and was afterwards submitted to the action of yellow rays by being covered with a piece of glass

of that color, and the image was soon made apparent by the specific action of the above-mentioned rays. Some time after, Mr. Gaudin repeated the same experiment upon a daguerreotype plate, and he also succeeded in producing the image by yellow light without any exposure to the action of the mercury. The effect produced by these two processes are so analogous, that it would be difficult, perhaps impossible, to decide which had been produced by mercury and which by yellow light. If the yellow rays perform in the development of the image the same action as the vapor of mercury, how are we to account for the effect? Yellow rays produce upon the plate those white microscopic dots or crystals which were assigned to the combination of mercury; but it is supposed that yellow rays cannot form a compound, that they can only modify the arrangements of the molecules of the surface and produce a sort of crystalization. And why should not mercury, by some electrical property, occasion a similar modification of crystalization without itself combining chemically with the plate. Already Dr. Moser, in his beautiful researches, has offered a theory upon the formation of the image by the vapors of mercury, in stating that these vapors develop latent yellow light, and that it is only as continuing yellow rays that the mercury brings out the image.

But it is more probable that the whole effect of the daguerreotype image is due to some electrical influence of light, and that mercury and yellow rays produce a like state of electricity.

Daguerre also recommended that we should raise the vapors of mercury by means of a spirit lamp, which heated the metal to a temperature of  $165^{\circ}$ , from which it was to cool gradually to  $120^{\circ}$ . But I have found that the temperature is quite immaterial, provided it is not raised to a degree which would cause sublimation. It has been ascertained that mercury evaporates at all temperatures above its freezing point, and those vapors are at all times sufficient to bring out the daguerreotype image. The only difference is the length of time required for the operation, this depending of course upon greater or less development of vapors. I have found that during the month of December, at a temperature of  $45^{\circ}$ , the image was brought out in two hours without heating the mercury, and I have been able, at the same temperature, to cause the development of the image in ten minutes, by placing the plate in the vacuum of an air-pump containing a small quantity of mercury.

I consider that the daguerreotype image is begun and finished by some electrical influence of light, that all the colored rays, as we have before mentioned, carry with them invisible rays which operate upon the plate, that the largest quantity of these accompany the blue rays, a lesser quantity the yellow, and a still less quantity the red. Thus the yellow ray is not entirely destitute of chemical power, although it operates very slightly upon the parts which have received the strong effect from the rays accompanying the blue, and, though enough to continue the effect begun, it is not enough to bite upon the parts not already effected. So that the operation begun by the in-

visible rays through the blue medium is completed by the small quantity of chemical rays accompanying the yellow light.

Without being able to decide which of the various kinds of rays emanating from the sun are those producing the photogenic effect, it is a well-known fact that they travel with all the rays of the spectrum, but that by far the largest proportion have a degree of refrangibility nearly agreeing with that of the blue rays, that the portion found with the yellow is considerably less, and still smaller with the red. In interposing a blue glass between the object and the image, the effect is nearly as great as if there was no medium; by the interposition of yellow glass the effect is considerably reduced, and almost totally impeded by red glass.

The great number of elements acting in the daguerreotype process, the ignorance in which we are concerning all their properties, the influence of various unknown causes, which undoubtedly perform a part in the operation, render the process very difficult and uncertain. So many conditions are requisite to a successful operation, that, indeed, it might be said that failure is the rule, and success the exception. This renders the task most delicate and arduous. The operator has constantly to overcome new difficulties, and the greatest is, perhaps, the want of power to appreciate the amount of operating rays existing at every moment. No photometer can be constructed; for the acting rays are not always in the same ratio to the intensity of light. It is true that, if it were possible to measure the comparative quantity of blue, yellow, and red lights, at all times, then it would be of considerable assistance in judging of the amount of photogenic light. But even this test would not be sufficient, for the acting rays are not strictly identical with the blue rays. Still, to be able to ascertain that there were no yellow or red vapors in the atmosphere, making, as it were, screens of those colors between the sun and the object, would be, no doubt, an important assistance.

It is to the influence of these vapors that the difference found by operators in various climates is due, which difference seemed at first irrational, but which can now easily be explained.

When the daguerreotype was first discovered, it was expected that southern climates would be more favorable than northern for the process, and that, in countries, where the sun constantly shines, the operation would be considerably shorter. This has not been proved to be the fact, and the following reason may be given for such an apparent anomaly. Light is more intense in the northern latitudes up to a certain degree, on account of its being reflected in all directions by the clouds disseminated in the atmosphere; whilst in the drier climates the open sky, instead of reflecting light, absorbs a great quantity of it. Of course, in speaking of clouds, it cannot be meant that a completely covered sky is more favorable than a sky without any clouds, for in this case the sun is entirely obscured. But still there are days when, although the disk of the sun is not seen from any part of the horizon, the thin clouds allow a much more considerable quantity of photogenic rays to be diffused and retained in the lower strata of the atmosphere than when there are no clouds, and

that by some imperceptible vapors the light has a yellow or red tint.

There is a curious fact which would seem to corroborate the argument in favor of greater intensity of light in northern climates. It is known that, by a provision of nature, all races of men are constitutionally adapted to the climates in which they are destined to live, that the inhabitants of the tropics can bear a much higher temperature than the inhabitants of the north. May it not be the same for light? The eyes of the inhabitants of the cloudy and snowy countries are adapted to bear a stronger light than those living in the south. In the course of my daguerreotype experience, I have observed that there is a comparatively greater number of Englishmen, than of Frenchmen, Spaniards, and Italians, capable of sitting for their portraits in a strong light, without being much incommoded. If this fact is correct, such a provision of nature would prove that generally light is more intense in the northern climates, and that it decreases gradually towards the equator.

It was at first expected that the climate of England, and countries similarly situated, would be unsuitable to the daguerreotype operation; nevertheless, it has turned out that this is one of the most favorable climates for the practice of the process. Putting out of the question the greatest part of the months of November and December, when the fog mixed with the smoke obstructs all light in London, I assert, from my own experience, that the climate of this metropolis is generally more propitious than that of Paris to photographic operations, for the representation of near objects, and for taking portraits. Of course, this observation does not apply to general views taken at a distance; for, in this case, although the light is photogenic, still the misty vapors which generally prevail in England are an obstacle to the formation of clear images. In such a case, the sensitive surface has quickly and fully been affected, but not in a clear and defined manner.

There is another curious fact connected with the photogenic operation, which is, that on the summits of high mountains the action of light upon the plate is not so intense as in the lower regions. A clever operator was sent two years ago from Paris into Italy to take daguerreotype views of the most interesting spots of that country. After having visited Rome, Florence, Naples, Venice, and other towns, and succeeded in producing a beautiful and curious collection, he wished, in crossing the Alps on his journey home, to obtain some views of the glaciers, and other Alpine scenes; but what was his surprise in finding that he could not obtain in one hour, and one hour and a half, in full sunshine, an image of these snowy mountains, having the same degree of force and distinctness as views which he had produced in less than fifteen minutes in the lower countries which he had just visited. The skill of this operator was great; he tried several times, and always with the same difficulty, and at length he abandoned the idea of bringing with him a perfect specimen.

The cause of this fact may be ascribed to the reason given before, that a sky without clouds absorbs a great quantity of light, and that

upon high mountains the rarity of the atmosphere would occasion a certain loss of light. But it remains to be ascertained to what degree the light is absorbed, or otherwise affected by the variation in the density of the air at great elevation above the surface of the earth.

Before concluding, I must speak of a very important improvement lately applied to the daguerreotype art, which has not as yet been published. I allude to a new process by which the daguerreotype plate may be engraved by a chemical operation, and formed into a metallic plate, from which may be printed an unlimited number of copies.

Since the discovery of the daguerreotype, the attention of many ingenious persons has been turned to this interesting subject; Mr. Donné, in Paris, Dr. Berrès, at Vienna, and Professor Grove, in England, have all separately made several attempts. The first two gentlemen have not published an account of their processes; but they have produced specimens which shew that engraving by the daguerreotype is not altogether a desperate case.

The process of Professor Grove consists in dissolving by the electrolyte process the parts of the picture which consist of pure silver: thus the plate is etched in, and transformed into an engraved plate for printing. This process is very ingenious, and creditable to the inventor; but it appears that the action of the galvanic battery sometimes extends to those parts which should remain unattached.

Mr. Fizeau, to whom the daguerreotype is already indebted for one of its greatest improvements, viz: the fixing of the image, is the fortunate discoverer of this new mode of engraving by a chemical operation.

By his process an unlimited number of copies may be obtained without impairing the plate. This discovery seems to complete the art, and to render it really useful.

Now, sculpture, painting, architecture, models from life,—all the productions of the fine arts,—portraits, &c., will be reproduced in their reality, while works of literature and science will be illustrated, not by wood-cuts, not by artistic engraved steel or copper-plates, but by the exact copies of the daguerreotype image.

Although the daguerreotype has hardly been in existence four years, it already ranks as one of the most prominent inventions of the present day, leaving scarcely any thing to look for in the way of improvement. It is true that it remains to find the means of reproducing the natural colors of objects; but, although there seems no dream too marvellous in the progress of discovery, still the idea of fixing the colors of the object in the camera obscura is so little in accordance with the present state of science and with the properties of the known elements, that we must be satisfied with the process as it is.

Trans. Soc. Arts, Mec. and Com.

*On some commercial Specimens of Green Glass.* By ROBERT WARINGTON, Esq.\*

Some short time since some green glass wine bottles were put into my hands for examination, the inner surface of which was covered with a thin film, having a dull and slightly opaque appearance. The question to be solved was, the possibility of removing this so as to restore the glass to its original transparency. My first impression, from the general appearance of the bottles, was that this dullness was to be attributed to some matter mechanically adherent to the surface, and that it probably arose from their having been washed with foul, greasy, or soapy water; but on examination this was found not to be the case, the surface of the glass having been evidently affected by the action of some corroding agent. Portions of the glass were therefore submitted to the action of a weak solution of tartaric acid, as the acid most likely to be present in wines; and in the course of twenty-four hours, the vessel, in which the digestion was conducted, was one-fourth part of beautiful crystals of bitartrate of lime. It was also strongly acted upon by diluted hydrochloric acid, forming a solution of chloride of calcium, and a gelatinous mass from the hydration of the silicic acid. From these preliminary experiments it was evident that a great excess of lime had been employed in the manufacture of the glass, and this had rendered it totally unfit for any of the ordinary purposes to which such bottles are applied. The glass was then submitted to analysis, and the routine followed, in this and the subsequent case, was similar to that adopted in the examination of all such compounds, I shall not detain the Society by going through the detail; suffice it to say, that the alkalis, soda and potash were separated by the fluoric acid process, and the potash estimated from the weighed quantity of the mixed sulphates thus obtained, by means of the double chloride of platinum and potassium.

The results, calculated to the 100 parts, are as follows:

Silica,	. . . . .	49.00
Lime,	. . . . .	24.75
Soda,	. . . . .	7.25
Potash,	. . . . .	2.00
Oxide of iron,	. . . . .	10.10
Alumina,	. . . . .	4.10
Magnesia,	. . . . .	2.00
Oxides of copper and manganese,	a trace	

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99.20

On making additional inquiries concerning these bottles, I found that they were offered to the consumer, the wine-merchant, at a lower price than the ordinary wine bottles, and that the venders urged strongly the superiority of their goods under the recommendation that they caused port wine to deposit its crust much sooner and firm-

\* Read before the Chemical Society of London, December 16th, 1844.

er, that is, adhering more tightly to the bottle, than would be the case where the common glass was employed. One gentleman had been a loser to a considerable amount from bottling a large quantity of white wine in these vessels, the bottles having become clouded, and the flavor of the wine, as a matter of consequence, being materially affected. As it was a question of scientific interest to ascertain to what extent the foregoing glass differed from our ordinary green glass of commerce, as occurring in the form of wine bottles, an analysis of this was undertaken, and the following are the results, calculated as before to the 100 parts:—

Silica, . . . . .	59.00
Lime, . . . . .	19.90
Soda, . . . . .	10.00
Potash, . . . . .	1.70
Oxide of iron, . . . . .	7.00
Alumina, . . . . .	1.20
Magnesia, . . . . .	0.50
Oxide of manganese, . . . . .	a trace
	<hr/>
	99.30

On comparing these results with the former, it will be seen that the total amount of bases present is far less, and calculating them out as silicates, the first analysis will show a deficiency of silicic acid amounting to about 20 parts on the 100.

It was about the period of this examination being terminated, that Professor Faraday, in a lecture at the Royal Institution on the manufacture of glass mirrors, exhibited a French glass bottle which had been subjected accidentally by Mr. Pepys, Jun., to the action of diluted sulphuric acid, in the proportions of one of acid to ten of water; in a short time this had, by its action on the glass, produced a most extraordinary and beautiful crystalization of sulphate of lime in small, detached, and rounded pyramidal masses, tightly adherent to the surface of the bottle. In consequence of this curious action, I was induced to submit the bottles under notice to a similar mixture, and after having been filled and loosely corked they were put aside in a place of safety. In the course of two or three weeks I was surprised one morning to find the floor of the laboratory covered with wet, which had apparently run from the direction where these bottles had been deposited, and on examination they were found to be cracked in all directions, the fissures being covered with a deposit of gelatinous silica: on breaking one of these, the whole internal surface was found lined, for the thickness of about one-fourth of an inch, with a mixture of sulphate of lime and silica, the crystalization of which had evidently caused the fracture of the bottles; in some places the glass was corroded completely through its substance.

Lond., Edinb., and Dubl. Philos. Mag.

*On the Conversion of the Essential Oil of Mustard into the Essential Oil of Garlic.* By CHARLES GERHARDT.

The artificial production of substances which are generated in the process of vegetation or in the animal œconomy becomes more and more frequent as organic chemistry advances. I shall now draw attention to one which seems to me to merit attention.

The essential oil to which garlic owes its characteristic odor has been recently analysed by M. Wertheim, and according to this chemist contains  $C^6 H^5 S$ . It is therefore a sulphuretted body like the essential oil of black mustard, but free from nitrogen.

From the analysis of M. Lœwig, and from the researches recently made by Dr. Will, we know that the essential oil of black mustard does not contain oxygen, and that its true formula is  $C^8 H^5 NS^2$ . The result of M. Simon's observations also appears to be, that the essential oil of the Scurvy grass (*Cochlearia*) is identical with that of mustard; moreover, M. Mubatka has proved that the horse-radish yields the same essential oil; and M. Wertheim has also met with it in the oil obtained by distilling the root of another cruciform plant, *Alliaria officinalis*, with water.

Considering these facts, and comparing the composition of the essential oil of garlic with that of mustard, I have been induced to try to convert one into the other by the means which science affords.

The oil of garlic only differs from that of mustard by the elements of cyanogen and of sulphur; we have, in fact,



In acting with potassium on the oil of mustard, I had to take away the cyanogen as well as a part of the sulphur, and to set free the oil of garlic.

My suspicions were entirely realized: when some pieces of potassium, previously dried over some chloride of calcium and rectified afresh, are thrown into the oil of mustard, it is attacked immediately. It may be slightly heated in a retort to favor the reaction; care must be taken, however, not to raise the temperature too much, for the substance might take fire, as has frequently happened to me.

If the operation is performed with care, the substance does not become much colored, some gas is disengaged, a white salt is deposited in the oil, and oil of garlic distils over. It is an interesting experiment, the difference of smell between the two oils being so striking: the smell of the garlic is immediately so evident, that this alone might suffice to prove that the conversion takes place as I have just described it.

But I desired to have chemical proofs. I therefore collected the oil which had been produced in the reaction; it was colorless, possessing in a high degree the characteristic odor of garlic, and presented the reactions described by M. Wertheim; shaken with a solution of nitrate of silver, it afforded a black precipitate of sulphuret; with the bichloride of mercury (when the aqueous solution was

slightly heated to dissolve more oil) it yielded a white, and with the bichloride of platinum a yellow, precipitate.

Burnt with oxide of copper, it yielded the same relative quantities of carbon and hydrogen as were obtained by M. Wertheim in the analysis of the oil extracted directly from garlic, and rectified without potassium, viz :

	My produce.	Rectified Oil of Garlic Wertheim.	Oil of Mustard.
Carbon,	58.8	59.1	48.5
Hydrogen,	8.4	8.2	5.1

I have not been able to make more analyses, from want of material.

The salt which separates in this reaction is *sulphocyanide of potassium*; in fact it dissolves easily in water, and gives with the persalts of iron the characteristic dark red color; it also yields a white precipitate, (protosulpho-cyanide of copper,) with a mixture of deuto-sulphate of copper and of protosulphate of iron, &c. I was unable to discover sulphuret or cyanide.

However, in rectifying the artificial oil of garlic a second time over potassium, I found much sulphuret in the residue. This reaction appears secondary. Besides, to understand the reaction well, it will be necessary again to examine the gas which is evolved, which want of material prevented me from doing.

The above results seem to be sufficiently conclusive to prove that the oil of mustard is really converted into the oil of garlic by the action of metallic potassium. I intend, however, to return soon to this metamorphosis.

Comptes Rendus, March 24, 1845.

### *Gutta Percha.*

The secretary described this substance to be the juice of a large indigenous forest tree in Singapore; and is obtained by cutting notches through the bark, when it exudes in the form of a milky juice which soon curdles. In its chemical properties it somewhat resembles Caoutchouc, but is much less elastic; it however possesses qualities, which that substance does not, which will render it of considerable value as a substitute for medical instruments in hot climates. The Gutta Percha, when dipped in water nearly at the boiling point, can readily be united, and becomes quite plastic, so as to be formed (before it cools below 130° to 140° Fahrenheit) into any required shape. and which it retains at any temperature below 110°; in this state it is very rigid and tough, and is used in Singapore for chopper handles, &c., in preference to buffalo horn, and does not appear to undergo any change in the hot damp climate of the Straits of Malacca. The secretary produced casts from medals, a rough lathe band, a short pipe, &c., which he had formed for the occasion, a soda-water bottle, containing the juice as collected from the tree, had been entirely inclosed by a covering of the Gutta Percha, which was as tough as leather, but by immersion in hot water for two or three minutes was removed, and formed again into a solid lump.—*Proc. Soc. Arts.*

Athenæum.

*Colorless Ink.*

Sir George Mackenzie has invented a substitute, in a colorless fluid, for black ink, "the nastiness of which," he says, "has been submitted to for ages." A history of the invention was lately read by him to the Royal Society of Edinburgh. A properly prepared paper, however, is required; and the ink becomes blue or black, according to the sort used. We have tried the ink on the prepared paper, and found it excellent—on unprepared paper it remained colorless. Neither will it, like common ink, stain the fingers, or anything else, except silver, and then may be easily removed. It is obvious that its cleanliness is the chief advantage of the invention, which will commend itself accordingly to the drawing-room, boudoir and library.

Ibid.

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*On the Epipolic Dispersion of Light.*

A paper was read by Sir J. W. Herschel, Bart., entitled, "On the Epipolic Dispersion of Light;" being a supplement to his paper, "On a Case of Superficial Color presented by a Homogeneous Liquid intimately Colorless." The author inquires whether the peculiar colored dispersion of white light intromitted into a solution of sulphate of quinine is the result of an analysis of the incident light into two distinct species, or merely of a simple subdivision, analogous to that which takes place in partial reflection, as exemplified in the colors of thin plates. He endeavors to ascertain the laws which regulate this singular mode of dispersion, which, for brevity, he terms *epipolic*, on account of the proximity of the seat of dispersion to the intromitting surface of the fluid. It might have been expected, that by passing the same incident beam successively through many such dispersive surfaces, the whole of the blue rays would at length be separated from it, and an orange or red residual beam be left; but the author establishes by numerous experiments the general fact, that an *epipoloical beam of light*, meaning thereby a beam that has been once transmitted through a quiferous solution, and undergone its dispersing action, is incapable of farther undergoing epipolic dispersion. There were only two liquids out of all those examined—namely, oil of turpentine and pyroxylic spirit—which, when interposed in the incident beams, act like the solutions of quinine in preventing the formation of the blue film; and the only solid in which the author discovered a similar power of epipolic dispersion is the green fluor of Alston Moor, and which by this action exhibits at its surface a fine deep blue color.—*Proc. Roy. Soc., Apl.* 10.

Ibid.

Statistics of Lowell Manufactures, January 1, 1844. Compiled from authentic sources.

Corporations.	Locks & Canals.	Merimack.	Hamilton.	Appleton.	Lowell.	Middlesex.
Incorporated,	1792	1822	1825	1838	1828	1830
Commenced operations,	1822	1823	1825	1838	1828	1830
Capital Stock,	600,000	2,000,000	1,000,000	600,000	600,000	950,000
Number of Mills,	2 Shops, Smithy,	5 & Print works,	3 & Print works	2	2-1 cot., 1 carp.	2 & 2 Dyehouses
Spindles,	Furnace.	40,384	21,248	11,776	6000 cot., besi. wool	7200
Looms,		1300	590	400	152 cot., 50 power	
Females employed,		1250	650	340	carpet, 40 hand do.	37 Br'delo. 122 Cas.
Males employed,	500	550	250	65	200	550
Yards made per week,	1225 tons wrou't	250,000	100,000	100,000	{ 2500 Car. 150	9000 Cassim. }
Bales of Cotton used in do.,	and cast iron	130	100	90	{ Rugs, 85,000.	1800 Br'dcloth }
Pounds of Cotton wrought in do.,	per annum.	56,000	42,000	36,000	40,000	1,000,000 lb. wool
Yards dyed and printed do.,	Machinery, R. R.					per annum and
Kind of Goods made,	Cars & Engines.	210,000	63,000	Sheetings &	Carpets, Rugs, &	3,000,000 tea-
	15,000 bushels	Prints & Sheet.	Prints, Flannels,	Shirtings, 14.	Negro Cloth.	sels.
	charcoal, 200	ings, No. 22 to	Sheetings, &c.,			
	chal. smith's	40.	No. 14 to 40.			
	coal, 400 tons	5000	3000	300	500	600
	hard coal.	200	500		500	1500
	200					
Tons Anthracite Coal per annum.	2300	13,000	6500	3440	{ Olive, 4000.	Lard, 15,000 }
Cords of Wood per annum,		30 ft.	13 ft.	13 ft.	{ Sperm, 4000.	Sperm, 5000 }
Gallons of Oil per annum,	13 ft.	24 ft.	42 ft.	42 ft.	60 ft.	17 and 21 ft.
Diameter of Water wheels,	14 ft.	Steam.	Steam & H. Air.	Steam.	Hot Air Furnace,	23 and 21 ft.
Length of do. for each mill,						Fur, and Steam.
How Warmed,	Hot Air Furnace.					

## Statistics of Lowell Manufactures—Continued.

Corporations.	Suffolk.	Tremont.	Lawrence.	Boott.	Massachusetts.	Total.
Incorporated,	1830	1830	1830	1835	1839	
Commenced operations,	1832	1832	1833-4	1836	1840	
Capital Stock,	600,000	600,000	1,500,000	1,200,000	1,200,000	10,650,000
Number of Mills,	2	2	5	4	4	33, exclusive Print-works &c.
Spindles,	11,776	11,520	32,640	31,524	27,008	201,076
Looms,	352	409	950	910	882	6194
Females employed,	340	360	900	780	725	6295
Males employed,	70	70	170	130	160	2345
Yards made per week,	90,000	115,000	210,000	180,000	260,000	1,425,800
Bales of Cotton used in do.,	90	75	180	145	200	1120
Pounds of Cotton wrought in do.,	32,000	30,000	65,000	59,000	80,000	440,000
Yards dyed and printed do.,						273,000
Kind of goods made,	Drillings, 14.	Sheetings & Shirtings, 1 <sup>4</sup>	Printing Cloths, Sheet and Shirt No. 14 to 50.	Drillings, 14. Shirtings, 40. Print'g Cloth, 40.	Sheetings, 13. Shirtings, 14. Drillings, 14.	
Tons Anthracite Coal per annum,	300	250	650	750	750	12,500
Cords of Wood per annum,	70	60	120	70	70	3290
Gallons of Oil per annum,	3500	3692	8217	7100	7100	67,849
Diameter of Water-wheels,	13 ft.	13 ft.	17 ft.	17 ft.	17 ft.	
Length of do. for each mill,	42 ft.	42 ft.	60 ft.	60 ft.	60 ft.	
How warmed,	Steam.	Steam.	Steam.	Steam and H. A.	Steam.	

Yards of Cloth per annum,	74,141,600
Pounds of Cotton consumed,	22,880,000
Assuming half to be Upland, and half New Orleans and Alabama, the consumption in bales, 361 lbs. each, is	58,240
A pound of Cotton averages $3\frac{1}{2}$ yards.	
100 lbs. Cotton will produce 89 lbs. Cloth.	
Average wages of Females, clear of board, per week,	\$1.75
Average wages of Males, clear of board, per day,	.70
Medium produce of a Loom, No. 14 yarn, 44 to 45 yards per day.	
“ “ “ No. 30 “ 30 “ “	
Average per Spindle, $1\frac{1}{10}$ yards per day.	
Average amount of wages paid per month,	\$150,000
Consumption of Starch per annum, (lbs.)	800,000
Consumption of Flour for Starch in Mills, Print Works, and Bleachery, bbls. per annum,	4,000
Consumption of Charcoal, bushels per annum,	600,000

The Locks and Canals Machine Shop, included among the 33 Mills, can furnish Machinery complete for a Mill of 5000 Spindles in four months; and lumber and materials are always at command, with which to build or rebuild a Mill in that time, if required. When building Mills, the Locks and Canals Company employ directly and indirectly from 1000 to 1200 hands.

To the above-named principal establishments may be added, the Lowell Water-Proofing, connected with the Middlesex Manufacturing Company; the extensive Powder Mills of O. M. Whipple, Esq.; the Lowell Bleachery, with a capital of \$50,000; Flannel Mill; Blanket Mill; Batting Mill; Paper Mill; Card and Whip Factory; Planing Machine; Reed Machine; Foundry; Grist and Saw Mills—together employing about 500 hands and a capital of \$500,000.

With regard to the health of persons employed in the mills, six of the females out of ten enjoy better health than before entering the mills; and of the males, one-half derive the same advantage. In their moral condition and character, they are not inferior to any portion of the community.

A very considerable portion of the wages of the operatives are deposited in the Lowell Institution for Savings.

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*On some Photographic Phenomena. By MR. SHAW.*

The main object of Mr. Shaw's discourse was to communicate details of original investigations pursued by him for the purpose of isolating and determining some of the conditions which either accelerate or retard the decomposition by light of the salts of silver generally. Mr. Shaw first described the known process of the Daguerréotype, taking occasion to notice that the film of iodine of silver, formed on the silver plate, may have its sensitiveness to light greatly increased by exposure to the vapor of bromine or chlorine,—bromine being the most effectual agent for this purpose. The quantity of bromine, however, which communicates the greatest degree of sensitiveness is

extremely minute, and excess of it destroyed the photographic character of the plate, by inducing a change, which was subsequently described. The difficulty of ascertaining this quantity is removed by exposing the plate to the vapor of a mixture of iodine and bromine, until it receives a violet hue. Mr. Shaw then described the subsequent stages of the operation: the placing the plate in the camera obscura to receive the image, its subsequent exposure to the vapor of mercury, where the picture first develops itself, the subsequent removal of the film of iodine of silver by hypo-sulphite of soda, and, finally, the fixing the picture by a film of gold. The chemical and physical changes accompanying these processes were adverted to. Mr. Shaw then stated, that if an impressed Daguerrréotype plate, after removal from the camera, and before introduction into the mercury box, be exposed to the vapor of chlorine, iodine, or bromine, however largely diluted with atmospheric air, the nascent picture is obliterated, so as to be no longer capable of development by the vapor of mercury. This fact, according to Mr. Shaw, has long been known, though a satisfactory explanation of it has hitherto been wanting. To obtain this explanation, Mr. Shaw directed his researches to the condition of the sensitive surface of the plate after the impression had been thus destroyed. By exposing some impressed plates, half covered by a metallic screen, to the vapor of bromine, and then placing them in the mercury box, Mr. Shaw found that both the covered and uncovered portions remained unchanged, but that an intensely white stain occurred in a line corresponding with the edge of the screen. This Mr. Shaw referred to the effects of light insinuating itself in the small space purposely left between the screen and the portion of the plate which it covered. From this experiment he established the fact, that when an impressed Daguerrréotype surface is exposed to either of the vapors already spoken of, the virtual impression is on the one hand destroyed, and, on the other, the sensitiveness to light is restored. As to the degree in which chlorine, iodine and bromine are capable of restoring the original character of the Daguerrréotype surface, it was ascertained that, after the development of the picture in the mercury box, the plate, if exposed to bromine, is again ready to receive an impression of light, even on the surface on which the mercury has condensed; so that a succession of pictures may be superimposed on each other on the same plate. Mr. Shaw also ascertained that full daylight is incapable of exciting any action on a sensitive surface in the presence of chlorine, iodine or bromine. From this circumstance was drawn the important practical conclusion, that the Daguerrréotype artist need no longer prepare his sensitive plate in the dark, but may fearlessly permit the sun's light to fall on it while it is receiving its sensitive coating, if he takes the precaution of exposing it for an instant to the vapor of bromine or iodine before placing it in the dark box in which it is conveyed to the camera. This may be valuably applied when taking pictures of movable objects. If, during the time of the plate being in the camera, the object, by moving, becomes distorted, it is only necessary to expose the impressed plate for an instant to the vapor of chlorine,

iodine or bromine, and it will be restored in every respect to its original condition; and this process may be repeated until a perfect impression is obtained. Mr. Shaw then entered on some experiments instituted with the view of ascertaining the conditions which either accelerate or retard the decomposition of salts of silver generally by light. He stated that pure iodide of silver is not, as is generally supposed, sensitive to light, and that it only becomes so when one of the substances used in its preparation—*i. e.* nitrate of silver or iodide of potassium—is in excess. Mr. Shaw then proceeded to describe experiments on chloride of silver by light. The chloride used by him was obtained from the nitrate of silver and hydro-chloric acid. This salt having been spread on slips of glass, was secured in glass tubes containing an atmosphere of the gas selected for experiment. The tube was then exposed to daylight, and the consequent darkening of the chloride observed. These investigations led Mr. Shaw to the interesting discovery that chloride of silver, after having been darkened by light, when placed in the dark for two or three hours, re-assumes its original whiteness, the chlorine combining under these circumstances with the reduced metal. On being again submitted to daylight, the chloride was again darkened, and again bleached by being placed in the dark: and Mr. Shaw proved that this alternate effect might be repeated indefinitely, without diminishing the sensitiveness of the salt. From this curious property of chloride of silver, Mr. Shaw was led to the construction of a photometer. In the course of his researches, Mr. Shaw arrived at another important discovery. He ascertained that some gases and vapors have a specific action on the chemical agency of light without reference to their colors. He observed that rays of light passing through a stratum of bromine had more influence on the chloride of silver than when they passed through an equal stratum of chlorine, notwithstanding the far deeper color of the former gas. Mr. Shaw concluded by describing another photometer, which, being constantly exposed to light, exhibits, by the change produced in it, the relative intensity of the light at the time of the observation. This instrument consists of a wedge-shaped glass vessel, filled with chlorine, and furnished with a long strip of glass, in the middle of which is a band of chloride of silver, the strips of glass being of an uniform grey color. When this instrument is exposed to light, the darkening commences on the lower end of the band of chloride of silver, and gradually progresses upwards, until the effect of the light is wholly counteracted by the retarding power of the gas through which it passes, and its contact with the salt. Mr. Shaw expressed his opinion that, by observations made on this instrument at regular intervals, a curve might be deduced, indicating the varying intensity of the light throughout the day.—*Proceed. Royal Institution, March 14, 1845.*

Atheræum.

*A notice respecting the cause of the beautiful White Rings which are seen round a luminous body when looked at through certain specimens of Calcareous Spar.* By SIR DAVID BREWSTER.

By varying the inclination of the spar, the rings increase and diminish, each of them in succession, contracting into a luminous spot and disappearing, and then expanding into rings as before. The two rings are produced from the two images formed by double refraction, and hence the light of one ring is oppositely polarized to that of the other. When the ordinary and extraordinary ray are refracted in lines parallel to the edge of the rhomb, which they are at different incidences, their respective rings disappear. At oblique incidences the rings are highly colored, and when the dispersive action is small they have a bright silvery whiteness. Sir David Brewster stated that they were produced by minute tubes in the mineral, of which there were many thousands in an inch, and that these tubes were parallel to one of the edges of the rhomb, viz: to that edge to which the refracted ray was parallel when each ring became a luminous spot.—*Proc. Brit. Assoc.* Ibid.

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*Practice of Electro-Metallurgy.* By MR. NAPIER.

Mr. Napier superintends the scientific department of the works of Messrs. Elkington. His present purpose was, not only to describe some curious points in the practice of electro-plating, but also to announce a new application of electricity in reducing metals from ores which, like that of copper, can be fused by a flux. 1. *As to Electro-plating:*—Mr. Napier commenced by noticing the known difference between solid and liquid conductors of electricity—*i. e.* that the latter are decomposed by the current which they convey; on this property the principle of all the electro processes rests. The mode in which the copper is deposited from the liquid sulphate on a surface connected with the zinc terminal of the battery was then illustrated theoretically by a diagram, and practically by a large sheet of cloth covered by these means. The object of this fabric is to furnish a roofing for houses, lining and ornamenting rooms, and covering railroad carriages;—not only water-proof, but also not liable to be set on fire by sparks falling on it. Mr. Napier here noticed the difficulty of maintaining that equable diffusion of the copper-salt through the solution which should insure the uniform deposit of the metal. This can only be effected by keeping either the liquid or the article in constant motion, or else by placing the latter horizontally at the bottom of the former—care being always taken to insure the solution being constantly saturated by suspending crystals of the salt in it. In plating goods with gold or silver, recourse is had to the cyanides of those metals. The preparation of the cyanide of potassium from the common yellow ferro-cyanide was described. This salt separates silver from the nitrate, and gold from the chloride, forming the required cyanide. An instantaneous gilding of several articles was effected before the audience. The subsequent processes of brushing and burnishing, by which the soundness of the work is tested, were then exhibited. 2. *As to the fabrication of solid silver articles:*—On a

model of metal, or plaster of Paris, or any other suitable material, is poured a compound of twelve parts of glue and three of treacle, melted together. This, when cooled, forms a perfectly flexible mould, from which any sculptured surface, even if there be much under-cutting on it, can be easily detached. Into a mould so prepared is poured a mixture of three parts tallow, one wax, and a half rosin. This dissolves at a low temperature; and when liquid, and previously to being poured into the mould, it receives half an ounce of phosphorus, dissolved in sulphuret of carbon. This, diffused through the melted mass thus described, gives it the property of reducing silver from its nitrate. The new model, then, taken from the mould, is moistened with nitrate of silver, and becomes covered with a thin film of that metal, on which copper is deposited by the battery-current. When this second mould is considered sufficiently thick, the fusible compound is melted away, the copper mould is protected at the back by non-conducting surface, generally a mixture of pitch and tar. Silver is then deposited within this mould, of any required solidity, from the solution of cyanide of silver and the battery-current; and, finally, the copper mould is dissolved by perchloride of iron, leaving the silver pure. By the same process, delicate organic textures are gilded. In all cases where it is desired to insure perfect metallic coating, the article (after having been washed with the sulphuret of carbon and phosphorus) is immersed first in a solution of nitrate of silver, and then of chloride of gold, both very dilute. 3. *As to the reduction of copper, &c., from their ores by electricity*:—Mr. Napier has proposed the following process for applying this discovery to practical purposes. He mixes the roasted ore with soda and lime, and places the whole on a bed of black lead tiles in a reverberatory furnace; these are connected with the zinc terminal of the battery, and the surface of the mass, when fused, is covered with an iron plate, which is put into connexion with the copper terminal. At the expiration of a period depending on the power of the battery, the complete extraction of the copper takes place, which is found collected at the bottom, amounting to, according to present experience, from twelve to sixteen times the weight of the zinc dissolved in the battery-cell. Whether these results are dependent throughout on the direct electrolysation of the fused mass, or if electrolysation be the primary effect, deranging the constitution of the compounds, and which, in connexion, with the intense heat, produces the results referred to, Mr. Napier cannot as yet say.—*Proceed. Roy. Ins., May 2.*

*Ibid.*

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*On the Manufacture of Wire Ropes.* By MR. CARPMAEL.

This manufacture has grown up within the last four or five years. Till the year 1839–40 there were no real wire-ropes in this country, *i. e.* no manipulation of wire, first producing strands, and then combining these strands into a single rope. Mr. Carpmael briefly noticed the improvements which had been made in the manufacture of hempen cordage during the last fifty years. He laid great stress on Captain Huddart's contrivance for varying the length of the yarns,

according to their distance from the centre of the rope, so that each, throughout its course, being kept at the same distance from the central strand, was subjected more nearly to the same amount of tension. The characteristic difference between the mechanical principles of the manufacture of the hempen and the wire-rope was then inculcated. *Twisting is essential to the structure of the former, but would be destructive of the latter fabric.* This principle, long overlooked, was discovered by Mr. Newall, the patentee of the improved wire-rope, and the object of his machinery is to carry that principle into effect. The wire-rope consists of a hempen core, the horizontal section of which exhibits seven equal circles,—six round a central one; these, according to a known geometrical law, touch the central circle, and also each other. Round this central core are six strands, formed exactly in the same way, except that while the central core is of hemp, (as is the core of the rope,) it is surrounded by six wires,—the diameters of these wires being equal to those of the yarns of the core; so that a section of the rope exhibits forty-nine equal circles, (thirty-six wire and thirteen hemp,) arranged in a sort of hexagonal form, the lines joining the centres of the hempen cores of each strand, producing a regular hexagon. Having exhibited the machines by which Mr. Newall *lays* the wires in the strands, avoiding all *twist*, Mr. Carpmael stated some of the purposes to which this manufacture had been applied. He premised, that the greatest strength is obtained when wire made of *hard* iron is used. Ropes thus manufactured are stronger, lighter, and cheaper, than hempen cordage bearing equal weights; consequently, when materials are raised from a depth in mines, a heavier load may be lifted with equal power whenever the wire-rope is used. For the same reason, this fabric is preferable in the fixed rigging of ships; and its value for railway purposes has been proved by decisive tests. As long as hempen ropes were used on the Blackwall Railway, there were often two or three breakages a-day. Since these have been superseded by the iron-wire, there have not occurred more than twelve fractures in twelve months, and during six thousand journeys.—*Proceed. Royal Inst., May 9.*

Ibid.

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*On the Electricity of Plants in the several Stages of their Development.* By REV. E. SIDNEY.

At the commencement, and at each division of this communication, Mr. Sidney dwelt on his desire to be considered, not as the promulgator of any theory on the influence of electricity on vegetable growth, but as the cautious observer of important and instructive facts. The following six propositions were maintained:—First, *Electricity appears to exercise an influence on growing plants.* After noticing the experiments of Maimbray, Nollett, Bertholon, Davy, and others, Mr. Sidney mentioned that he had himself accelerated the growth of a hyacinth in a common glass jar by giving it sparks, on alternate days from the machine. Secondly, *Fluids contained in vegetable*

*tissues possess a high conducting energy, as compared with the ordinary substances found on the earth's surface.* In confirmation of this, several experiments were shown to prove the conducting energy of vegetable points. The fact was also stated, that it was impossible to give an electric shock to more than one at each extremity of a circle of persons standing on a *grass-plat*. This the operator easily did when they transferred themselves to a *gravel-walk*. In the former instance, the current went across the grass, instead of being carried from one human body to another. A jar, of forty-six square inches of coated surface, was discharged by a blade of grass in little more than four minutes of time, whereas it required three times that period to produce the same effect by means of a metallic needle. Mr. Sidney said, however, that probably the blade of grass had many points. Mr. Sidney also showed a drawing of Mr. Weekes's Electroscope with vegetable points, which Mr. Weekes prefers to any artificial ones he has yet tried in the open air during the passage of a cloud. Thirdly, *There are indications of adaptation to electrical influences in the differences of form of parts of plants in the different stages of their development.* Thus the moistened germ of a vegetating seed becomes a good conductor. The ascending and descending portions are, in the majority of instances, pointed. Plants designed for a rapid growth have generally a strong pubescence. Those destined to meet the variations of the seasons have often thorns or prickles. As surface becomes needed for other purposes, the pointed is changed to the expansive form of the vegetable organ. As the period of fruiting approaches, it seems desirable that electricity should be carried off. Hence the hairs, &c., fall off or dry away. The apparent exception is that of *pappi*, which have a special office for conveyance of seeds. Gardeners put metallic hoops over fruiting melons which tends to take off electricity and shade them. Fourthly, Mr. Sidney inquired, *Whether there are not natural phenomena tending to confirm these views?* Vines and hops are said to grow rapidly during, and after, a thunderstorm, and peas to pod after a tempest. As to hops, these effects may be ascribed to the destruction of aphides, &c., by the lightning: but as these animals are tenacious of life, the storm which destroyed the parasitic insect, would probably also kill the plant which fed it. Again, it is observed, that there are no plants wherever simooms, which appear to result from a highly electrical state of the atmosphere, occur. Mr. Brydone's observation of the presence of electricity in the atmosphere of Mount Etna, in places where vegetation was absent, and its deficiency wherever vegetation luxuriated, also indicated the influence of plants in distributing atmospheric electricity. This was illustrated by an experiment with a cone of chalk, with a piece of moss on one part. The part without the moss brought near the machine, only slightly affected the electrometer. The moss carried off the electricity entirely. Fifthly, Mr. Sidney suggested the inquiry, *Whether the forms and geographical distribution of certain species of plants did not indicate design with reference to their electrical properties and uses.* The prevalence of the fir tribes in high latitudes was noted. These trees are

characterised by their needle-shaped foliage, and it was argued that the conducting power, with which this form invested them, might modify dryness and cold, and aid in the precipitation of snow. Mr. Sidney concluded by suggesting *modes of applying electricity to practical agriculture and horticulture*. First, *with regard to the free electricity in the atmosphere*. Having mentioned the experiments of Mr. Foster, of Finbrassie, on growing crops, Mr. Sidney described modifications of this arrangement made by Prof. E. Solly, in his experiments at the Horticultural Garden, and by himself. The latter consist of wires suspended over the growing crop from other wires which are kept parallel to the horizon by being fastened to insulated rods. Secondly, *Electricity artificially generated by the voltaic pile*. Mr. Sidney has found that potatoes, mustard and cress, cinerarias, fuchsias, and other plants, have their development, and, in some instances, their productiveness, increased by being made to grow between a copper and a zinc plate connected by a conducting wire; while, on the other hand, geraniums and balsams are destroyed by the same influence. Mr. Sidney at present believes that the application of electricity to vegetable growth may be made available in horticulture. The question as to agriculture may be decided when more experiments are tried, and the philosophy of the experiments fully determined.—*Proceed. Roy. Soc., May 16.* Athenæum.

*Exhibition of French Arts and Manufactures at a Meeting of the Philosophical Society of Glasgow.*

At a late meeting of the Philosophical Society of Glasgow, specimens were exhibited of French art and manufacture, purchased by Government at the late Exposition in Paris for the School of Design in London, and which have been sent down for inspection to the Institution in Glasgow. These articles are described as presenting a high standard of excellence in various branches of art and manufacture. "The first we noticed," says the *Scottish Guardian*, "was a drawing or pattern for a rug, being a specimen of the manner in which French designs are executed for the manufacture of these articles. It might be about twelve inches long, by about six or eight in breadth, and consisted of a series of figures of flowers, drawn and colored with exquisite skill, finished with the minuteness and nicety of miniature painting, and showing an amount of labor which we were informed would be poorly compensated to the artist by fourteen guineas, the price at which the pattern was purchased. There were a number of specimens of pottery, and glass manufacture, and jars and vases cast in metal, remarkable for their classic elegance of form and beauty of design. Amongst these we observed the following: A valuable bronze vase, with an allegorical design, representing two groups of figures, the most prominent of which were Justice and Peace on one side, and Patience and Hope on the other, all the figures being produced with admirable sculptural effect. A jar in common Beauvais ware—the coarsest potter's clay, in fact—showed in a remarkable manner the value of Art in moulding forms of perfect

grace and symmetry out of the most ordinary and inexpensive materials. One of these elegant jars might cost sixpence, and we believe that in France, as we have no doubt will soon be the case in this country also, they are much sought after for household purposes. A vase cast in argent-platina, of singularly fine proportions; the chasing elaborated with the minuteness of insect-work; produced in the *atelier* of M. Rudof; cost forty guineas, being considered a perfect specimen of the art, and without its equal as yet in British manufacture. Glass-china vase, from the work called *Choisi le Roi*; value, 16*l*. In this specimen the classical proportions of the other vases were produced in a material of exquisite delicacy, combining the purity of crystal with the pearly whiteness and transparency of the finest porcelain, and affording a ground susceptible to the minutest shades of the pencil. Vases of this description are painted by the hands of ladies; and the present specimen bore testimony to the industry and taste with which the paintings are executed. Two Terra Cottas, moulded in common tile-clay, and intended for holding flowers;—both very pretty examples of the same union of taste and economy which we have already noticed. Four specimens of enameled ware, another cheap and beautiful invention, applicable to a variety of purposes, such as plates, dishes, and other articles made of earthenware. The figures are moulded in *intaglio*, instead of in *bas-relief*, and the mould may be wrought by any man who can make bricks and tiles, and with equal ease and expedition. When the cast is hardened, it is covered with a coat of enamel or varnish, in the usual way; and the lowest lines or hollows of the *intaglio* being designed to throw up the shaded parts of the picture, they receive the thickest coating of varnish, while the more elevated lines take on the least; and the mixture of light and shade thus produced is so well managed as to give the picture all the prominence to the eye of *bas-relief*. Amongst the more finished and valuable specimens of porcelain manufacture was the Adelaide Vase, painted in enamel, in imitation of Middle-Age Art, the painting, as in a former instance, being done with the pencil. We also noticed a slab of lava, enameled and painted in a beautiful manner; and learned that slabs of this seemingly impracticable material are now used in Paris for the purpose of painting on their enameled surface the names of the streets. They are thus rendered impervious to atmospheric influence, and are considered indestructible. Amongst the other casts in metal were part of a bronze architrave of the door of the church of the Magdalene at Paris, and casts of ornamented outer plates of locks, in iron and in brass, cleverly designed and moulded; besides a variety of bronze figures, &c. Some ingenious specimens were also shown of carving in leather, in imitation of casting; and specimens of the ornamental flooring used in the houses in France, where they have no carpets. But the French are rapidly acquiring a taste for this domestic luxury, and have fairly commenced the manufacture of carpeting, which promises soon to become an item of great importance in the trade of the country. Considerable attention was paid to a specimen of their carpeting exhibited in the room, and which exceeded ours as much in the beauty

of the pattern, as it fell short of the British manufacture in the fineness of the fabric. In like manner, the white damask table-cloth was unknown in France eight years ago, but is now both manufactured and used in the country; and a specimen exhibited on the present occasion evinced still greater progress than in the case of the carpet manufacture. But however deficient the French may be in the production of these articles, as compared with our own manufactures, the profuse display of gorgeous damask silk, from the factories of Tours and Lyons, must have challenged universal admiration by the superiority of their fabric and designs. Some of the richest effects were brought out in these manufactures by using glass thread, which is prepared so fine as to be capable of being tied in knots without breaking, and woven in every respect like ordinary thread. But the fabric which excited the strongest interest, both on account of its beauty and its novelty and ingenuity, was a large square of wool mosaic, or India-rubber cloth, a manufacture peculiar to France and some parts of Germany. The pattern was perhaps the most perfect in respect of design of any work of Art in the exhibition. The flowers and leaves were copies from nature, and were much admired for their botanical accuracy. Even the least prominent of the plants represented in the composition, such as the fronds or leaves of ferns, were delineated with so much fidelity as to enable botanists to distinguish the different species, and give them their specific names! The triumph of Art in this instance is the more remarkable, that after the designs passed from the hands of the pattern-drawer, it was wrought into the fabric by one of the most complicated processes that can well be imagined. The pattern is in fact produced in the fabric by the *ends* of threads standing out transversely from the foundation of India-rubber cloth, and not, as is usually the case, by the threads being interwoven longitudinally. The cloth is sold at 5*l.* a yard."

Athenæum.

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*On the Flexure of a Uniform Bar supported by a number of equal pressures applied at equi-distant points, and on the positions proper for the application of these pressures, in order to prevent any sensible alteration of the length of the bar by small flexure.*  
By G. B. AIRY, Esq.

In the use of standards of length, two points have gradually attracted more and more of attention—the application of supports in such a manner as to produce no irregularities of flexure, and the application of such supports as will permit the standard freely to yield to the expansive or contractive effects of temperature. Since these points were insisted on by Captain Kater and Mr. Baily, the principle adopted in the support of standards has been to sustain them upon two rollers in a definite position. In whatever way a bar be supported, flexure must be tolerated; and the only points aimed at are, that it shall produce no sensible effects on the measured length, or that it shall always be the same. Several bars in use are notched at the ends to the centre of their thickness, and the defining points are

in the axis of the bar; and in these cases there is good reason to believe that the effects of any flexure are nearly insensible. In the standard scale of this society, the divisions are upon the upper surface, and the interval between these is not unaffected by flexure. In this case there may be some fear of the bar acquiring a permanent flexure, but this may be checked by an examination of the divisions which Mr. Baily caused to be cut upon the other sides of the cylinder. Still it is necessary to be assured that, as far as the best theories of flexure enable us to judge, the upper surface is not sensibly lengthened or shortened. Very simple considerations will convince us that bars supported on two rollers, placed at the distance of one-fourth of the length from each end, must have the length of their upper surface necessarily elongated. The ill effects of this elongation are nearly obviated in the geodetic standards, which are notched to the centre; and may be considered as discoverable in the Society's scale by the use of the divisions on the opposite side. But it was the wish of the members of the committee of superintendence of the national standards, not only to place the divisions in or near to the axis of the bar, by which means the *effect* of flexure would be obviated, but also to make the actual flexure as small as possible by a proper choice of the points of support. It was also recognized as a desirable principle, that the bar should be subject to as little strain as possible, and, therefore, that it should be supported at numerous points. Great facility is given to the arrangements for supporting a bar with definite pressures applied at special points, by the use of levers. Thus, if any portion of the bar rest upon two rollers which are placed at the ends of a lever, and if the fulcrum of a lever (whether movable or not) be in its centre, the pressures upwards produced by these rollers will necessarily be equal. If there be another such lever, and if the fulcrum of this and the former be upon the extremities of a third lever, and if its fulcrum be at its centre, then the pressures upwards produced by the four rollers will be equal. By this arrangement of rollers and levers, one-half of the bar may be supported. If another similar system be applied to support the other half of the bar, the pressures produced by its four rollers will also be equal among themselves; and if the bar be laid symmetrically upon them all, the individual pressures will be equal. In this manner, by altering the lengths of the arms of the levers, any number of pressures, bearing any proportion to each other, and applied at any points whatever, may be produced. And the levers may be so arranged as to occupy a very small space. Mr. Baily decided on the application of eight rollers for the support of the national standard; and the author undertook to investigate the positions of the rollers which, supposing the pressures and the intervals equal, would so sustain the bar that its surface should not be sensibly lengthened. In the progress of the investigation, he was struck with an analogy in the results for two, for four, and for eight rollers, which seemed to indicate that the process could easily be generalized; and, on trying it in the general form, it proved to be exactly what he expected. The author goes on to describe the nature of the investigation, which is as follows.—It is

first assumed, that the flexure is so small that the mere curvature of a neutral line will not produce a sensible alteration in its length; that the extension of a surface is proportional to the momentum of the bending force; and that, when the momenta are equal, the extension produced by a bending force downwards, and the contraction produced by a bending force upwards, are equal. The method of applying these assumptions is to estimate the curvature at any point, by conceiving the section of the bar at that point, and the whole of the bar on one side of that point, to be held perfectly firm; and then to use the algebraic sum of the momentum of the weight of the remaining part of the bar downwards, and of the momentum of the supporting pressures under that part of the bar upwards, as the representation of the molecular extension in the neighborhood of that section. From this statement it will easily be seen that the curvature of the bar is expressed by a discontinuous function. In shifting our ideal section gradually from one support to another, the momentum produced by the weight of the portion of the bar increases continuously; as also does the momentum of the pressures of the supports; and, therefore, through that portion of the bar the change of curvature is continuous. But on passing a new support, although the change in the momentum of the weight of the portion of the bar, and the change in the momentum of the pressures of the former supports, are both continuous, yet there is now suddenly introduced a new pressure; and this interrupts the continuity of the change. From this consideration it appears that, between two supports, the whole effect of the molecular extension and contraction, as produced by curvature, is to be found by integration; but that, when this integration is performed, the whole of the various parts can only be combined by summation. These remarks are common to every method of supporting a bar. But when the supporting pressures are all equal, and their points of application are equally distant, the summation to which allusion is made can, for all the intervals between the supports, be effected by the processes of the calculus of differences. For the parts exterior to terminal supports, these processes will not apply. The author then proceeds with the mathematical investigation of the general expression for the extension of surface of the portion of the bar lying between any two of its contiguous supports.—*Proceed. Astron. Soc., Jan. 10.*

Athenæum.

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*Ivory Engraving, or Durertype—a newly-invented process. By*  
HENRY DIRCKS.

Great as are the improvements which have been made in the art of engraving, there is no reason to believe we have yet arrived at perfection in any of its various departments. For a considerable period no method besides that of wood-engraving was known as suitable for printing along with type. Stereotyping, though it affords a metallic duplicate of the engraved wood block, and is so far useful for multiplying such works, yet is of no avail in the production of

original designs, and it was not until we were made acquainted with Gypsography and Glyphography, that we were put in possession of methods at all likely to compete with, if not supersede, wood engraving.

It is not my object to extend my remarks to those other methods of engraving applying to copper, steel, stone, &c., which even those most superficially acquainted with typography must be aware cannot be printed off along with letter-press. An early partiality for typographical works made me long desirous of re-discovering the supposed peculiar art by which Albert Durer produced those remarkable effects, particularly in cross-hatching, which have perplexed all who studied his prints, and have been the fruitful source of much speculation whether they are from true wood engravings, or absolute copper-plates, with all the lines in relief, the result of biting-in with nitric acid; thus etching the lights, instead of, as usual, etching the shadows, or lines to be printed. It may not be known to the general reader, that the shading produced by cross-hatching has ever been one of the principal difficulties in the art of wood engraving, not from its impossibility, but its extreme tediousness; and is, therefore, in all old prints particularly, very sparingly introduced, and much oftener entirely omitted. The frequent interlacing, or cross-hatching, as well as the spirited freedom of his lines, form a remarkable feature in Albert Durer's engravings. It was in 1837 that I designed a means of surmounting the main difficulty of the cross-hatching, which I could produce with the greatest freedom, either as an original effect, or to copy, as I then did, one of Albert Durer's prints. At that time the electrotpe process was not known, or I should have employed it for one part of my invention, instead of stereotyping, which I found it requisite to abandon, as involving too much difficulty, labor, and expense. My method of engraving calls in aid either stereotyping or electrotyping. Its peculiarity is the facility it affords for *copying*, without any great skill on the part of the copyist. Indeed, in this respect it probably offers a dangerous temptation to the committal of forgery. Though myself a mere amateur, I have copied a print of Albert Durer's with all the exactitude that a steady hand could pass a tracer over lines already prepared. How much superior, however, must be the labor of one skilled in engraving. My method is as follows:

1. I take a plate of clear, thin, flatted glass, round the edge of which is to be pasted a ribbon of card, one quarter of an inch broad, flat to the glass, and close to its outer edge, forming a white margin, or frame, all round; a few drops of spirits of turpentine are to be rubbed over the glass, but on the card side only; next melt a little pure white bees'-wax, and holding the glass, if small, over a lamp, or a larger one over a chafing dish, pour upon it the wax, allowing all the superfluous portion to run over the card margin, the object being not to have it anywhere thicker than the card. The turpentine causes it to be very adhesive.

2. The glass thus prepared may be laid, with the varnished side

uppermost, on any print, which will appear distinctly through the wax varnish, and in this state is ready for copying with the graver.

3. The needles, or gravers, I propose using, may be of ivory, (and hence, or from Durer's name, may be chosen a distinctive title for this invention;) the softness and thinness of the coating, as also the smoothness of the glossy surface, favoring their employment. For open-lined engravings like Albert Durer's, maps, plans, and the like, ivory needles would answer every purpose, and without scratching the glass. To copy a fine copper-plate might require a steel point. The varnish is merely cut through, as in etching copper-plate.

4. A cast off the glass plate so prepared is what is next most wanted; and it was here my original difficulty occurred. By the electrotype process a copper printing block may be at once obtained, backed with soft metal, and raised on wood.

Such is my method, which a variety of circumstances have concurred to frustrate my bringing forward, but chiefly the want of sufficient leisure to prepare suitable specimens. That in the hands of able artists its capabilities are very surprising, I feel satisfied, and its affording an extremely easy means of copying, to those who are entirely amateurs at engraving, or drawing, is self-evident; arising from its not requiring the *reversing* of objects. Thus the ancient method of absolutely writing with a stiletto on a wax tablet, may now be advantageously revived, and when electrotyped may even be printed with letter press. Prints on paper, silk, cotton, &c.; pencil drawings, writing, embroidery, leaves of plants, medals, &c., may all be exactly traced by placing them under the glass plate, saving all the tediousness of first drawing and then etching. Some time back I intimated to private friends, what I still think might be carried out, that my method of engraving offers a light and suitable employment for females, who might be advantageously occupied in copying for the electotypist.

Before concluding, I wish to observe that my invention may, on a hasty glance, appear similar to, or even seem to be borrowed from, the Gypsographic and Glyphographic processes. But such is not the case. The only similarity is that of cutting down through a soft substance to a hard one; and the publication of those methods has certainly, so far, deprived me of the credit I might earlier have obtained for that useful part of the invention, of which no advantage had at that period been taken. But as regards employing a *transparent medium*, I believe my method distinctly stands alone. I can only say, in reference to my own knowledge of it, it is perfectly original in every respect; and I shall be sincerely pleased should these few hints be found serviceable in at all advancing an art I much admire.

January 5th, 1845.

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The favorable reception which my paper, in the *Athenæum* of the 11th ult., has met with, induces me, first, to extend my remarks on Ivory Engraving, or Durer-type; and, secondly, to add observations on a hitherto unpublished process for obtaining a transfer to the copper-plate to be engraved.

I. The perfections of the Durertype will depend much on the thinness both of the glass and the wax varnish. A very beautiful and thin glass is prepared in small plates for microscopic purposes, and which might be used for very fine engravings, not exceeding four to six inches square, while for larger subjects the flatted window glass would have to be substituted. Engravings which entirely cover the wax surface with lines require no further preparations than metalizing the surface with the finest black lead or bronze powder, and submitting the work, so prepared, to galvanic action in a proper electrotyping apparatus. When the engraving presents large white spaces, the wax in such parts should be thickened with a preparation of melted wax, by which means the electrotype produced from such surface will present indentations of the required depth in the electrotype cast. It does not occur to amateurs that the engraved wax is absolutely the *mould*, and that the electrotype itself forms the face of the printing block. One of the periodicals, last month, states that this "alleged invention" is "identical in all its material features with that known under the name of Glyphography," and yet the writer entitles the article a "new method of *copying* engravings." The peculiarity of my process, as before stated, is a facility in *copying* by employing a *transparent* medium; let my invention be judged by what I propose, and then I am sure its "identity" with Glyphography will disappear. As I admire the Glyphographic process I may state, without disparagement of that mode of engraving, that it does not of itself afford any facility whatever in *copying* engravings, and like all other kinds of engravings, it requires a transfer, by hand, or mechanically, of the subject to be copied. By the Durertype process the engraved copy is made at once, direct from the original, with the graver, no previous transfer of outlines being of any utility. The essential principle of Glyphography consists in cutting through a soft substance down to a metallic, and therefore opaque plate; my process substitutes a glass, or transparent plate. Thus differing materially and avoiding altogether the tediousness of first copying an original with the pencil, and then engraving the lines so drawn out.

As every art must be expected to be somewhat rude while in its infancy, I may reasonably surmise, that in the progress of the application of the means I have suggested, it will be found possible, by proper and delicate management, to lay exceedingly thin waxed glass on a Daguerreotype plate, and copy much of the magic picture as penciled by nature herself! Mr. C. J. Jordan, the talented discoverer of Electro-metallurgy, and himself a printer, suggests the employment of my Durertype plate, as a substitute for the ground glass in the camera obscura, to be there engraved.

II. The transferring of a drawing or engraving to a copper-plate can be attained by a very simple process, the phenomena of which does not appear very explicable; and is no doubt capable of being considerably extended and varied. I give the result as mentioned to me by a friend. He put into my hands a highly polished copper-plate, the surface of which presents a reversed impression of a copper-plate engraving as taken from paper, without in the slightest de-

gree affecting the original. I have had the copper by me a fortnight, and see no change; names that were printed on the paper may still be read backwards on the copper, presenting an excellent outline to guide the artist in the employment of his graver. This singular effect, I feel pleasure in adding, may be produced without difficulty or expense. Take a well polished copper-plate of the dimensions required for engraving a copy the exact size of the original: lay the drawn, written, or printed original with its face against the bright copper; fold a sheet of paper over it to keep it from shifting; place it under a weight to press the paper everywhere evenly against the copper, and rest it on a hot plate, stove, or even the hob of a fire-grate, for about ten minutes, in which time having acquired a moderate heat it must be removed. When opened out, the transfer will be found complete and perfect, if the operation has been properly conducted, which only experience can dictate. If too hot, it vanishes altogether, and if too cool, the lines are ill-defined. When obtained sufficiently perfect, it may be brought out still better by the vapor of iodine, or mercury, or even by simply breathing upon the plate.

In experimenting with a slip cut from a newspaper, it was curious to observe on the copper the confusion produced by the double printed surfaces of the paper. Anything written with common ink affords a very distinct transfer. The darkening effect of the slightest taint of ammonia on the paper would lead to the supposition that a chemical preparation of the ink might be provided, capable of giving a more vivid character to the transferred print. It is also possible that other polished metallic surfaces may be equally well acted on; the application of the heat may be varied by using a hot-press. The beauty and advantages of this singular property possessed by heated polished plates, in contact with printed paper,\* is, that the original suffers not the slightest deterioration, while the truth of the transfer is insured by close contact with the surface to be afterwards engraved. I shall perhaps be better understood by instancing the usual mode of transfer to an etching ground on the surface of which, and *not* on the copper, the transfer is made; but by the Calorotype process, (as I think it may be with propriety called,) every line must be a faithful transfer from the original to the copper surface, so much so that two skilful engravers might produce independent copper-plates, the prints from which would not be distinguishable, the one from the other. This process would have great advantages where it was desirable to print *engravings* in colors, because, any subject being transferred wholly to a given number of plates, only such lines as would be wanted for printing red, need be engraved on one plate, all those lines for blue on another, all for brown on a third, and so on with a separate plate for each color employed. Indeed my own process of Ivory engraving, or Durer-type, offers the same advantage, with the additional one of giving a raised surface.

The increasing demand for illustrated works and ornamental printing deserves every encouragement that can be devised, and must, I

\* I should, however, mention that a polished copper-plate, kept a day or two in contact only, with a print, also acquires a pretty good impression.

conceive, proportionably render each contribution valuable that tends in any way to popularize such productions. I confess it has been with the hope of adding at least some little to the general store of typographical information, that I have again ventured to come forward with suggestions for further improvements.

HENRY DIRCKS.

Athenæum.

February 1st, 1845.

### *Aeriferous Millstones.*

M. Guevin Bonchon and Company sent to the Exposition of France several millstones. Among them was one of Train's *aëriferous* millstones, the arrangement of which allows the circulation of cold air under the millstones, in order to prevent the heating, which so often does injury to the grist. These millstones are generally 1.3 metre (4 ft. 3 in.) in diameter, and are thus formed. Four orifices,

Fig. 1.

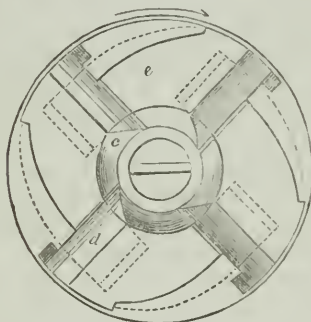
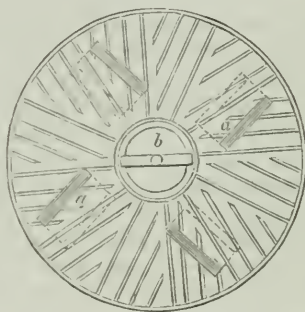


Fig. 2.



*a, a*, starting from near the centre of the millstone to within  $5\frac{1}{2}$  inches of the periphery, and pierced sloping, are made through the whole thickness of the stone. The mill is provided in the centre with a cast iron eye or box, *b*, in the form of a cone reversed, and on its external part a wrought iron circle, *c*, covering by about 8 inches the upper surface of the millstone. Iron plates, *d*, are strongly rivetted on to the iron eye and circle, some inclined  $45^{\circ}$  over the orifices, others forming quadrants of curves, *e*, perpendicular to the great circle, and serving to lead the air, which is thus forced to pass into the orifices, *a*. By these means a current of air is produced by the rotation of the millstone.

Civ. Eng. and Arc. Jour.

### *Improvement in the Manufacture of Glass for Optical Purposes.*

At the Society of Arts, last week, a paper, by Mr. Claudet, "On Improvements in the Manufacture of Glass for Optical Purposes," was read. Heretofore the manufacture of glass fit for the purpose of the optician has been a matter involving great uncertainty and difficulty. About 1744, a Swiss, named Guinand, in making some ex-

periments in the construction of the telescope, was led to endeavor to make glass for himself, and from his labors arose the first process by which glass could be made with certainty sufficiently good in quality for the construction of optical instruments. With the death of Guinand his secret was partially lost. The invention which forms the subject of Mr. Claudet's paper is founded upon the process of Guinand, and is due to a French glass manufacturer named Bontemps, whose attention was first drawn to the subject by the son of Guinand himself. The chief defect in optical glass consisted in striæ and spots; these arose from the great difficulty of properly mixing the materials when in a state of fusion; it was impossible to stir the melted mass, because the temperature was so high as to destroy instruments of metal, and besides by introducing them into the glass it would have been tinged with color, according to the nature of the metal employed. The method used by M. Bontemps is to introduce the iron rod used in stirring into a clay cylinder closed at one end, so that the glass is entirely protected from the injurious action of the iron; the ingredients are thus effectually mingled; the glass is then suffered to cool gradually, the crucible broken with care, and the mass sawed transversely into slices, so that lenses may be obtained of the diameter of the crucible. Very large lenses have been produced by these means, and two of about three feet in diameter are now in progress of manufacture for the Royal Observatory at Paris.

Mec. Mag.

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*Process of Anastatic Printing. By PROF. FARRADAY.*

Anastatic printing is the ἀνάστασις (the fresh raising up) of copies from a printed sheet of paper. This, by the process described, may be done to an indefinite extent. The philosophy of this process and its practice were explained and exhibited. The philosophy of the Anastatic printing rests on a few known properties of the articles employed. Thus, *water attracts water, and oil, oil; though each mutually repels the other. Metals are much more easily wetted with oil than with water, but they will readily be moistened by a weak solution of gum; and, finally, this property, of their becoming wet by water, is greatly increased by phosphatic acid.* To these properties of oil, water, and the metals, may be added, as one of the principles of Anastatic printing, *the readiness with which part of the ink of any newly printed book or engraving can be transferred by pressure to any smooth surface beneath.* If, for example, a corner of a newspaper be fixed on a white sheet of paper, and then pressed, or rubbed with a paper-knife, the letters will be distinctly seen in reverse on the paper. This effect is known to book-binders, and our readers may have seen, especially in the case of books bound soon after publication, pages disfigured by the "setting off;" or transfer of the ink of the opposite page. Such being the properties of the matters concerned in Anastatic printing, the process is simple. The printed paper, whether letter-press or engraving, is first moistened with dilute nitric acid, and then pressed with considerable force, by a roller, on a perfectly clean surface of zinc. By this means every

part of the sheet of paper is brought into contact with the plate of zinc. The acid, with which the unprinted part of the paper is saturated, *etches* the metal, and the printed portion *sets off* on it in the manner already described, so that the zinc surface presents a complete reverse-copy of the work. The principles before specified are now brought into operation. The zinc plate, thus prepared, is washed with a solution of gum in weak phosphatic acid. This liquid is attracted by the etched surface, which it freely wets, while it is repelled by the oil of the ink in which the writing or drawing on the plate is traced. A leathern roller, covered with ink, is then passed over the plate, when a converse effect ensues. The repulsion between the oily ink and the watery surface over which the roller passes, prevents any soiling of the *unfigured parts* of the zinc plate, while the attraction between oil and oil causes the ink to be distributed over the *printed portions*. In this condition the Anastatic plate is complete, and impressions are pulled from it in the common lithographic process. Mr. Faraday concluded his description by stating, that when it was required to apply the Anastatic printing to very old originals, which do not *set off* their ink on pressure, the following expedient was resorted to: The page, or print, is soaked in a solution, first of potass, then of tartaric acid. This produces a perfect diffusion of minute crystals of bi-tartrate of potass through the texture of the unprinted part of the paper. As this salt resists oil, the ink-roller may now be passed over the surface without transferring any of its contents, except to the printed parts. The tartrate is then washed out of the paper, and the operation proceeded with as before, commencing with the moistening by nitric acid. During the description of the process, a complete Anastatic copy of a page of a printed work, with wood-cuts, was made by Mr. Woods, who had brought his press and workmen.—*Proceed. Royal Inst., April 25, 1845.*

Ibid.

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*Description of a Self-Registering Thermometer.* By MR. MANSFIELD HARRISON. *Communicated to the Royal Society April 17th, 1845.*

The instrument here described is composed of two parallel bars, the one of iron and the other of copper, united at their lower end, and registering their differences of expansion by heat, by means of a series of multiplying levers, carrying a pencil which is made to press on paper wound round a cylinder moved by clock-work.

Lond., Edinb., and Dubl. Philos. Mag.

JOURNAL  
OF  
THE FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY.

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SEPTEMBER, 1845.

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CIVIL ENGINEERING.

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*On the Expansion of Brickwork, (considered with reference to the Chimney Shaft, at Mr. Cubitt's Works, at Pimlico.)*

Paper read at the Institution of British Architects, April, 1845.

The chimney to which I propose to direct your attention is an object of interest, from the proof it affords of the power of heat, in expanding materials—in which such expansion is generally overlooked. The shaft is encased in a tower, without being any where in contact with it, or any part of the adjoining buildings: great care having been taken while building, to keep the chimney quite free from all the other work. None of the floors or landings of the tower were allowed to touch the shaft; the intention being to permit it to move up and down freely, as the heat acted upon it—thus preventing that displacement of materials in the tower which would otherwise have happened. This shaft is built of brick, which is perhaps of all materials, the least affected by change of temperature, and yet it is found that the shaft differs in height considerably, even with the change arising from the comparatively slight variation in the heat of the smoke and vapors passing through it. This variation is never more than 250 Fahr., and yet the shaft at the height of 90 feet alters, or rises, nearly  $\frac{1}{8}$ th inch with this change only. This shows that the materials with which an architect, engineer, or builder, has to deal, are always varying in their bulk, and that no two sides of a building are at all times of the same height, except when there is an unusually uniform and still atmosphere; and of course the external walls of the tower which support the floor, from which this variation is measured, are also subject to

constant changes, by alteration in the heat of the atmosphere. Thus it is seen that a variation in size with every change of temperature, must take place in the external parts of all buildings, even a garden wall cannot be of the same height on both sides, when there is more sun, wind, or rain, on the one side than on the other.

The chimney is parallel, and the internal diameter is 5 feet; its height from the surface is 108 feet. The foundations were laid at a depth suitable to the nature of the soil, being on a layer of gravel 11 feet from the level of the ground; and in order to spread the weight of the building over a large surface, a bed of concrete was formed 23 feet square, and 3 feet in thickness; on this a mass of brickwork 21 feet square, 2 feet thick, was laid in cement, forming a solid block, equal to being in one piece of stone, like a large solid landing, to carry the upper work. In the centre of this foundation, and through the whole of the before-mentioned brickwork, a well 18 inches diameter was left, and taken down below the water line deep enough to insure the lower extremity of a lightning conductor being always under water. The walls of the tower are 14 inches thick from the bottom to the top, and inclose a space of 14 ft. 9 in. square in the clear at base, and 1 foot less at the top: the tower being tapering, stairs are built in the walls for the purpose of communicating with the belfry and clock room, and with a supply cistern for steam boilers; also for easy access to the top of the chimney, to ascertain what is occurring there, with respect to the temperature of the vapors emitted, and that in case too much heat were given out or wasted at the top, where it could no longer be of any service, such waste might not happen without means of ascertaining the fact that it was occurring.

The smoke shaft in the centre is for 24 ft. 3 in. upward, from footings  $1\frac{1}{2}$  bricks in thickness; but at the base, where the flues enter, it is strengthened round the openings by an additional brick in thickness. So far the work is done with bricks of the usual form and size; but above this, they are segment-shaped, and were made purposely for the shaft. In the second piece, 11 ft. 3 in. in height, the work is 10 inches thick; in the third piece, 40 ft. 3 in. in height, it is 9 inches in thickness; in the fourth piece, 17 ft. 9 in. in height, it is 8 inches; in the fifth piece, 17 ft. 3 in. in height, it is 7 inches, and in the remaining height the work is 6 inches in thickness.

The first object aimed at in designing the tower, was to conceal the chimney shaft; the appearance of which was thought to be objectionable to the neighborhood. As it was intended that no black smoke should be suffered to escape, it seemed that if the chimney were concealed from view, its existence might remain unknown; but it was also considered that other direct advantages might be gained to justify the erection and compensate for the increased outlay. These expected advantages have been realized.

A considerable saving of fuel has been effected owing to the chimney being protected from a cold atmosphere, from rain or snow beating against it, which would rob it of its heat, in proportion as the evaporation from the outer surface was more or less rapid. There seems, however, as much propriety in protecting a chimney from cool-

ing influences, as there is in clothing any other part of the flue, or steam boiler itself; for in order to insure a sufficient supply of air to support combustion, it is necessary that the ascending smoke and vapors should have been heated, so as to become in the required degree lighter than the external air. In the degree that the strength or force of the draught is required to be increased, so must the air and vapors given off from the furnace be allowed to pass at a higher temperature; consequently the amount of the difference of heat lost from a chimney exposed to the weather, and from one clothed, is by so much a clear gain.

The height of the tower affords sufficient pressure to make available a capacious cistern fixed at its top for supplying the steam boilers with water, thus giving great power to the person who has charge of the engine, should occasion require its being brought into action, either through the failure of the force pump or through evaporation of water from the boilers, or neglect in filling them at the proper time, thereby diminishing to a very great extent the risk of explosion from such causes, or at least rendering the boiler less liable to be deranged.

It will be observed that the shaft is much thinner than it could have been had it been erected without its casing. The quantity of brick-work saved in the shaft, and the economy of fuel, will go very far towards paying the additional cost of the tower, which may therefore be considered as a matter of very little, if any, additional cost, when the advantages are all taken into account. Civ. Eng. and Arc. Jour.

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TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

GENTLEMEN:

The following article is taken from the Boston Courier, of July 15th. The facts, I believe, are all correctly stated. The tonnage of each year (excepting 1838, of which I have no official report,) corresponds with the amounts contained in authentic documents in my possession.

It is not often that we are able to obtain all the facts appertaining to a case of this sort; and when we do succeed in procuring them, I think they ought to be preserved.

I therefore suggest the propriety of republishing it in the Journal, and am,

Very respectfully, yours,

CHARLES ELLET, JR.

*Boston, July 15th, 1845.*

*Wear of Railroad Iron.*

There has been a great deal of discussion and speculation during the last two years, as to the probable duration of railroad iron when exposed to a heavy traffic; and there are few subjects on which the opinions of practical men have differed more.

We have, however, at last, the means of forming a very safe estimate of the durability of a 56 pounds to the yard edge rail, when well laid, on an even and well-adjusted track.

The first ten miles of the second track of the Lowell road was first brought into use in 1838, after the "fish-belly rail" had been found inadequate. The new rail was of the H pattern—the form now most generally approved.

The following table shows the number of tons which passed over the road, in each year, from 1838, when this rail was first used, until July, 1845, when the company commenced making extensive repairs:

In 1838, about	-	-	-	-	60,000 tons.
1839,	-	-	-	-	70,000 "
1840,	-	-	-	-	73,000 "
1841,	-	-	-	-	86,000 "
1842,	-	-	-	-	91,000 "
1843,	-	-	-	-	115,000 "
1844,	-	-	-	-	150,000 "
1845, (to July,)	-	-	-	-	75,000 "

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Total freight, - - 720,000 "

In addition to this quantity, there has been transported, annually, about 16,000 tons of passengers and baggage, or in seven and a half years, 120,000 "

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Which makes the aggregate tonnage about 840,000 tons.

One *half* of this quantity only has passed over the second track, which, up to this time, therefore, has sustained 420,000 tons. The question is now, What effect has this tonnage produced? Is the rail visibly injured by it?

The company have relieved us of the necessity of all speculation on this point, by taking up several considerable stretches of this rail in 1844; and they are *now* making still further changes—one about *a mile long*, near the three-mile stone, and the other about *half a mile*, near South-Woburn. They will be compelled to make additional renewals this year, and probably to change the iron on the whole of this ten miles in the next year. The durability of this rail may, therefore, be set down at 500,000 tons. The lowest estimate we have ever seen of the power of a good edge rail, is 1,000,000 tons.

In 1841 and 1842, the Lowell company took up 26 miles of the "fish-belly" rail, and laid down a new iron of about 56 pounds per yard; some portion of it was 60 pounds, and that which they are now using is 63 pounds iron per yard. This change of iron cost \$121,559, after deducting the proceeds of the old iron, or about \$4700 per mile.

The new iron was heavier than the old, which, of course, increased the cost of making the change; but, on the other hand, the new iron was purchased while railroad iron was admitted free of duty, which *reduced* the cost.

If we make the proper allowance for these two circumstances, we will find that the cost of taking up one track of 56 pounds iron, and

replacing it by a new track of the same weight, is very nearly \$5000 per mile.

If we then divide this sum by 500,000 tons, the amount of trade which will have destroyed it, we shall obtain *one cent per ton per mile* for the value of the wear of iron on this road. This is a larger result than we should have looked for; but as the company receive more than *five cents per mile per ton* for all the freight they carry, they can afford to renew their iron and still make reasonable profits.

*Report of L. O. REYNOLDS, Chief Engineer of the Central Railroad and Banking Company of Georgia, to the Stockholders.*

ENGINEER'S DEPARTMENT, CENTRAL RAILROAD, }  
Savannah, April 5th, 1845. }

To R. R. CUYLER, Esq., President:

Sir: The period of another annual convention of the Stockholders of this Company being at hand, I submit to you the following Report of the operations of the Road for the last year, and its condition at this time.

The fiscal year of the Company terminates with the month of November, but it was deemed proper to delay the report to the present time, that a supplementary statement may be appended, shewing the operations of the Company as nearly up to the period of the convention of the stockholders as possible.

The following table exhibits the earnings of the Road for the year ending November 30th, 1844:

*Earnings of the Road for the year ending November 30th, 1844.*

Year	Months.	Num'r of Passen.	Amount of Passage Money.	U. S. Mail.	Freight.	Total Receipts.	Total for same period previous year.
1843	December	1534	3555.19	\$1715	\$25,983.44	\$31,253.63	\$17,453.27
1844	January	1527	3956.48	1715	24,086.99	29,758.47	19,294.40
"	February	1574	4536.39	1715	19,453.23	25,704.62	11,929.95
"	March	1446	4276.75	1715	19,876.11	25,867.86	7,944.44
"	April	1322	3237.00	1715	12,724.87	17,676.87	7,486.88
"	May	1569	4446.75	1715	13,930.84	20,092.59	10,107.07
"	June	1035	2433.18	1715	6,639.86	10,808.04	7,707.43
"	July	1187	2267.82	1715	8,120.82	12,103.64	8,080.77
"	August	2632	2325.75	1715	13,639.61	18,181.36	11,142.77
"	Sept'mb'r	833	1425.88	1715	32,270.02	35,410.90	21,447.59
"	October	1433	4340.12	1715	44,907.60	50,962.72	35,236.94
"	Novemb'r	1332	3539.00	1715	45,349.31	50,603.31	42,612.94
Total,		17,524	40,841.31	20,580	\$267,002.70	\$328,424.01	\$201,464.45

Total number of bales Cotton transported during the year, 77,437.

The expenses of working the road for the above period, have been as follows:

*Maintenance of Way*—Including all repairs and materials for repairs of Road, depots, turn-outs, wells, cisterns, bridges, &c.,

\$66,273.01

Amount carried forward,

Amount brought forward,	\$ 66,273.04
<i>Maintenance of Motive Power and Cars</i> —Including all materials used in repairs of engines and cars, all labor for the same, wages of engine men, firemen, oil, tallow, fuel, water, &c.,	35,344.43
<i>Transportation Expenses</i> —Including depot expenses, wages of conductors and train hands, salaries of agents and clerks, insurance on cotton, damage, &c.,	44,544.44
<i>Incidental Expenses</i> —Printing and stationary,	1,557.61
<b>Total,</b>	<b>147,719.52</b>

## RECAPITULATION.

Earnings of the Road for the year ending November 30, 1844,	328,424.01
Expenses for the same period,	147,719.52

Profits, \$ 180,704.49

The earnings for the four months, ending April 1st, 1845, have been as follows :

*Earnings of the Road for the four months ending April 1st, 1845.*

Year	Month.	No. of Pas.	Passenger and Mail Money.	Bales Cotton.	Total Earning.	Total for same period previous year.
1844	December	1206	4,576.88	12,517	34,886.74	31,253.63
1845	January	1345	4,755.05	14,207	31,415.21	29,758.47
"	February	1041	4,649.75	18,898	36,787.40	25,704.63
"	March	1138	5,351.13	15,260	39,248.57	25,867.86
		4730	\$19,332.21	60,882	\$142,337.92	\$112,584.59

Increase in these four months over the corresponding period last year, \$29,753.33, or 26½ per cent.

The distance run by the trains during the year, is as follows:—

Passenger trains, - - - - - 119,556 miles.

Freight trains, - - - - - 91,298 "

**Total,** - - - - - **210,854 "**

In performing this distance, 3605 cords of wood have been consumed, which is one cord for every 59 miles run.

The amount of tonnage transported during the year, is equal to 1,056,128 tons hauled one mile.

It must be borne in mind, that for a considerable part of the year the trains go very light in one direction. In the fall, when the up-freight greatly exceeds the downward, and before the cotton crop begins to come to market, the down trains run nearly empty. The reverse is the case a few months later, when the up freight falls off, and cotton presses forward; and there is a short period in the summer that there is very little freight in either direction. It is presumed

that this irregularity will gradually cease, and that the freighting business will, after a time, be more equally distributed throughout the year. Other articles of transportation, such as lumber, staves, fuel, &c., will seek this channel, and afford freight for the down trains in the summer and fall, when other freight is dull.

The cost of working the Road, and maintaining it during the last year, including all expenses, has been as follows:

	<i>Cents.</i>
For maintenance of way per mile run, - - - -	31.4
“ maintenance of motive power and cars, - - - -	16.7
“ transportation expenses, - - - - -	21.1
“ contingencies, - - - - -	0.8
Total, - - - - -	70c.

The Depot grounds at either end of the Road, were considered amply sufficient for any business that might offer, but the experience of the past year has shown that they must be extended, particularly the cotton yards. It is in contemplation to make additions to them during the present year, and a purchase of ground for this purpose has already been made. The want of a suitable passenger-house at the Savannah Depot has long been felt; a plan has been prepared, and it is proposed to erect the building during the approaching summer.

A small engine house is also required at the centre of the Road, at which a spare passenger and freight engine may be kept to supply the place of any engine that may be disabled on the Road.

Our motive power now consists of sixteen engines, all in working order, except the “Georgia,” which we are remodeling. She will be fitted up as a freight engine, with eight wheels.

An order has been given for four more; our number will then be twenty. Eleven for freight, and nine for passengers.

We now have one hundred and fifty eight-wheel freight cars, and intend increasing the number to two hundred for the next season’s business.

We have all of our wheels cast at a Foundry in this city, and fit them up in our own shops; by this course we get a more perfect article, and at no greater cost than to order from the North. We have not had an instance of the failure of the wheels and axles fitted up by our own workmen.

The condition of the road is much improved since my last report, and is as good now as at any former period.

The good policy of keeping an efficient force on the repairs is more and more manifest, in the regularity with which the trains perform their trips.

We have now had sufficient experience to enable us to make a fair estimate of the annual cost of keeping up the Road. I find the average duration of pine string pieces is six years; of pine cross-ties, eight years; and of ribbon, four years.

There is in the whole Road about 130,000 cross-ties; 12,300,000

feet (board measure) of string pieces, and 600,000 feet (board measure) of ribbon. We now renew the cross-ties with cypress, which, I think, will last at least ten years.

Then $\frac{1}{8}$ or 16,250 cross-ties per annum, at 25 cents,	\$ 4,062.50
$\frac{1}{8}$ or 2,050,000 feet (b. m.) string pieces, at \$6 per M,	12,300.00
$\frac{1}{4}$ or 150,000 feet (b. m.) ribbon, at \$12 per M,	1,800.00
Repairs of Trestle-work and Bridges,	8,000.00
Spikes,	2,000.00
Deterioration of Iron,	22,500.00
Repairs of Wells, Pumps, Cisterns, Turn-outs, Depots, Turn-tables, and contingencies, say	7,987.50
Thirty gangs of Laborers, of six each gang, including Overseers and Supervisors, at \$110 per gang per month,	39,600.00
Salaries of Superintendent and Assistant,	1,750.00
Total,	<hr/> \$ 100,000.00

An average of about \$ 526 per mile per annum. The expense during the past year has been \$ 348—about two-thirds of the above sum. As the cross-ties and string-pieces of the western part of the Road are as yet not much decayed, and most of the Bridges are sound, it will be some years before the cost of repairs will reach the maximum; but I am confident that with the amount of business that may reasonably be expected, the cost of maintaining the Road will not fall much short of one hundred thousand dollars per annum.

It is not so easy to make an estimate of the other annual expenses attending the operations of the Road, as the maintenance of the machinery and the transportation expenses are governed, in a great degree, by the amount of business done. I am confident, however, that with a business that would yield an income of \$ 450,000 per annum, the whole expense of operating the Road would not exceed \$ 200,000; and I am equally confident the receipts of the road will, at no distant period, exceed that amount.

The opinions of engineers on the subject of the duration of Railroad Iron, are extremely variant, and the system has not been in operation a sufficient time in this country, to afford data for an exact estimate.

There are about 8000 tons of iron on our Road, which has been laid down an average of five years. On the eastern part of the Road, near this city, several miles have been in use eight years; and during the first year and a half of the time, bore the transit of twelve trains per day in each direction, transporting material for the heavy embankment adjoining the city, and I cannot perceive any difference in the condition of this and other portions of the iron, which have not borne half the amount of tonnage.

I have set down the annual deterioration at five per cent., and I am satisfied that will be found sufficient. The cost, thus far, has not been one-tenth of that sum.

I intimated in my last report the intention of substituting embankments for a considerable portion of the trestle bridging on the line.

We have commenced this operation at the long trestle work near the 100 mile station, and it will be continued on a moderate scale during the year.

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*Report on the Atmospheric Railway.*

The Select Committee appointed to inquire into the merits of the Atmospheric System of Railway, have examined the matters to them referred, and have agreed to the following report:

Your Committee have given their best attention to this interesting subject. Adverting to the great number of Railway Bills now in progress, they consider that one of the most practical results of this inquiry would be lost if their report were delayed until after these Bills had passed through Committee, and a decision had already been made on their comparative merits.

Your Committee have endeavored therefore to present to the House, with as little delay as is consistent with the due discharge of their duty, the evidence which they have taken, and the opinions to which they have come, and they trust that their labor may not prove altogether useless to the Committees that have to decide on the particular railway schemes now pending.

The House are aware that a railway on the atmospheric principle is already in operation between Kingstown and Dalkey in Ireland.

The first object of your Committee was to make a full inquiry into the result of this experiment. From Mr. Gibbons, Mr. Bergin, and Mr. Vignoles, gentlemen officially connected with the Kingstown and Dublin and Kingstown and Dalkey Railways, they received the fullest and frankest evidence on all the points connected with their management. Your Committee had also the advantage of the opinion of Dr. Robinson, of Armagh, whose scientific knowledge and acquirements render his testimony particularly valuable on the theoretical merits of such an invention.

From this evidence, and from that of Mr. Samuda, it appears that the Dalkey line has been open for nineteen months, that it has worked with regularity and safety throughout all the vicissitudes of temperature, and that the few interruptions which have occurred have arisen rather from the inexperience of the attendants, than from any material defect of the system.

Your Committee find, moreover, that high velocities have been attained with proportional loads on an incline averaging 1 in 115, within a course in which the power is applied only during one mile and an eighth.

These results have been displayed under circumstances which afford no fair criterion of what may be expected elsewhere; for, in addition to the curves on the line, which would have been considered objectionable, if not impracticable, for locomotive engines, there are alleged to exist defects in the machinery and apparatus, occasioned partly by the difficulties of the situation, partly by mistakes inseparable from a first attempt, which very seriously detract from the ef-

iciency of the power employed, for the remedy of which provision has been made in the experiments now in progress.

These are important facts. They establish the mechanical efficiency of the atmospheric power to convey with regularity, speed, and security, the traffic upon one section of pipe between two termini; and your Committee have since been satisfied, by the evidence of Messrs. Brunel, Cubitt, and Vignoles, that there is no mechanical difficulty which will oppose the working of the same system upon a line of any length. They are further confirmed in this opinion by the conduct of the Dalkey and Kingstown Directors, who have at this moment before Parliament a proposition to extend their atmospheric line to Bray.

In addition to the witnesses already examined, your Committee have had the advantage of hearing the objections urged by Messrs. Nicholson, Stephenson, and Locke, against the adoption of the atmospheric principle, and the grounds of their preference for the locomotive now in use.

Your Committee must refer the House to the valuable evidence given by these gentlemen. It will be seen that great difference of opinion exists between them and the other witnesses to whom your Committee have before referred, both in their estimation of what has already been effected, and in their calculations of future improvement.

But without entering upon all the controverted points, your Committee have no hesitation in stating, that a single atmospheric line is superior to a double locomotive line both in regularity and safety, inasmuch as it makes collisions impossible except at crossing places, and excludes all the danger and irregularity arising from casualties to engines or their tenders. Now the importance of these considerations will be best estimated by a reference to the return of accidents for fifteen months appended to this report. It will there be seen that there have been during that period fourteen collisions upon the road, and thirteen accidents to engines, which would altogether have been avoided on the atmospheric system, and that these casualties entailed the loss of eleven lives, as well as the serious injury of forty-five persons. From the other twenty accidents, common to both systems, resulted only four deaths, and two persons injured. There is certainly one case in which the engine passed uninjured over cattle lying upon the road, together with its entire train; but then against this security derived from the advantage of weight in surmounting obstacles, must be set the great danger to which the engine driver and stoker are exposed, standing as they do upon an open platform.

Your Committee desire also to bring to the attention of the House a peculiarity of the atmospheric system which has been adduced by the objectors to prove how unsuited it must be profitably to carry on a small and irregular traffic; namely, that the greatest proportion of the expenses of haulage on the atmospheric principle are constant, and cannot be materially reduced, however small the amount of the traffic may be. This is, no doubt, a serious objection to the economy of the atmospheric system under the circumstances above alluded to.

But, on the other hand, as the expenses do not increase in proportion to the frequency of the trains, it is to the interest of Companies adopting the atmospheric principle to increase the amount of their traffic by running frequent light trains, at low rates of fare; by which the convenience of the public must be greatly promoted. Upon an Atmospheric Railway the moving power is most economically applied by dividing the weight to be carried into a considerable number of light trains. By locomotive engines, on the contrary, the power is most conveniently applied by concentrating the traffic in a smaller number of heavier trains. The rate of speed at which trains of moderate weight can be conveyed on an atmospheric line, makes comparatively little difference in the cost of conveyance; while the cost of moving trains by locomotive engines increases rapidly with the speed.

Now when it is considered that we surrender to great monopolies the regulation of all the arteries of communication throughout the kingdom, that it depends in a great measure upon their view of their interest when we shall travel, at what speed we shall travel, and what we shall pay, it becomes a material consideration, in balancing the advantages insured to the public by rival systems, to estimate not so much what they respectively can do, but what, in the pursuit of their own emolument, they will do.

The main objections of the opponents of the atmospheric system seem to rest, 1st, on the supposed increased expense of the atmospheric apparatus over and above the saving made in the construction of the road; 2d, on the inconvenience and irregularity attending upon a single line. With reference to the last point, your Committee felt it their duty to direct their first attention to the question of security, and they have already stated that there is more security in a single atmospheric line than in a double locomotive. They may further observe, that they find the majority of the engineers who have been examined are decidedly of opinion that any ordinary traffic might be carried on with regularity and convenience by a single atmospheric line.

Mr. Brunel has proposed to double the line in those places where trains are intended to meet; and he has further shown that in a hilly country, with long planes of sufficient inclination to allow of the descent of trains by the unaided power of gravity, it might be possible to effect this object without the expense of the tube.

With respect to expense, and to some other contested points, your Committee do not feel themselves competent to report a decided opinion. It would scarcely be possible at the present time to institute a fair comparison of a system which has had fifteen years of growth and development, with another which is as yet in its infancy. That comparison would, after all, be very uncertain; it must depend much on details of which we are ignorant; much on scientific knowledge which we do not possess.

There are, however, questions of practical importance, having reference to the present state of the Railway Bills before the House, to which your Committee consider themselves bound to advert.

There is a doubt raised in the reports of the Board of Trade, whether the atmospheric system has been sufficiently tested to justify the preference of a line which can only be worked on the atmospheric system, or which presents gradients less favorable than a competing line for the use of the locomotive engine.

If it were practicable to suspend all railway legislation until the result of the Devon and Cornwall, and of the Epsom and Croydon Atmospheric lines were known, it would be perhaps the most cautious and prudent course to wait that result; but such a course, independent of all considerations of expediency, is evidently impracticable. Your Committee venture, therefore, to express their opinion to the House, that in deciding between competing lines of railway, those which have been set out to suit the atmospheric principle ought not to be considered as open to valid objection merely on account of their having gradients too severe for the locomotive, nor should they be tested in comparison with other lines solely by the degree of their suitability to the use of the locomotive.

No doubt in matters like these experience alone can decide the ultimate result, but your Committee think that there is ample evidence which would justify the adoption of an atmospheric line at the present time. All the witnesses they have examined concur in its mechanical success. Mr. Bidder says, "I consider the mechanical problem as solved, whether the atmosphere could be made an efficient tractive agent. There can be no question about that; and the apparatus worked, as far as I observed, very well. The only question in my mind was as to the commercial application of it." Mr. Stephenson admits that under certain circumstances of gradients, (1315,) and under certain circumstances of traffic without reference to gradients, (1204,) the atmospheric system would be preferable.

While your Committee have thus expressed a strong opinion in favor of the general merits of the atmospheric principle, they feel that experience can alone determine under what circumstances of traffic or of country the preference to either system should be given.

Railway Mag.

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*First Annual Report of the Directors of the South Carolina Railroad Company, for the year ending December 31st, 1844.*

CHARLESTON, S. C., Feb. 11th, 1845.

The Directors of the South Carolina Railroad Company have the honor to submit herewith their *First Annual Report*, for the year ending on the 31st of December, 1844. Since the last annual meeting at Columbia of the Stockholders of the Louisville, Cincinnati and Charleston Railroad Company, and of the South Carolina Canal and Railroad Company, the consolidation of these two Companies, under an act of the Legislature of South Carolina, bearing date the 19th December, 1843, has been perfected; and all the chartered "Rights, Privileges and Property" of both are now centered in and enjoyed by one corporation, under the name of the South Carolina Railroad Company.

The gross receipts, current expenses, and nett income, on the two Roads, previous to consolidation, for the year 1843, were:

From 1st Jan. to 1st July, on Hamburg Road,	\$ 171,241.48
“ “ “ on Columbia Branch,	44,740.73
Total,	<u>215,982.21</u>
Current Expenses on Hamburg Road,	\$103,147.76
Current Expenses on Columbia Branch,	20,108.86
Interest on sterling Bonds and floating note debt,	59,000.00
	<u>182,256.62</u>
Nett Income,	33,725.59
From 1st July to 31st Dec., 1843, on Hamburg Road,	177,074.03
“ “ “ “ on Columbia Branch,	49,835.01
	<u>226,904.04</u>
Current Expenses on Hamburg Road, including three Locomotives,	\$ 111,673.16
Current Expenses on Columbia Branch,	18,437.52
Interest on sterling Bonds and floating note debt,	59,000.00
	<u>189,110.68</u>
Nett income,	\$ 37,798.36

From which nett incomes the Board of Directors declared, for the first half-year, a dividend of \$1 per share; and from the last half-year \$1.25 per share, making for the year \$2.25 on each share, and equivalent to 3 per cent. on the par value of \$75 on the Road stock.

The above statement of expenditures and nett revenue would not seem to accord, on comparison, with the statements made in the report of 1843. In that exhibit, as the Companies had not been consolidated, and the interest on the sterling bonds and floating debt of the Louisville, Cincinnati, and Charleston Railroad Company had been previously provided for out of the funds of that Company, and charged in their books—it was not, and very properly, by the Auditor of the South Carolina Canal and Railroad Company, brought into the account of current expenses paid by him against the Railroad income. As under the head of current expenses, is now correctly embraced all these charges for interest, it was necessary, in a comparative exhibit of expenditures and of nett income for the two years, to embrace interest on bonds and note debt in those for 1843, as they had been embodied in the consolidated Company account for 1844.

The gross receipts, current expenses, and nett income, for the year 1844, on the Roads, as consolidated, were:

From 1st January to 1st July, receipts,	\$ 244,035.14
Expenses, including one locomotive and extra burden cars,	185,438.07
	<u>58,597.07</u>
Nett income,	58,597.07

From 1st July to 1st January, 1845, receipts,	288,835.81
Expenses, including two locomotives, patents, extra passenger and burden cars, and machinery,	207,234.24
Nett income,	\$ 81,598.57

From the above a dividend of \$1.50 was declared on each share for the first half year, and \$2.25 for the last half year, making \$3.75 on each share, and equivalent to 5 per cent. interest on the par cost on each share now represented in the Company. From the exhibit now made, it appears that the gross receipts for the year 1844 exceeded those of 1843 by \$89,967.70, and the nett profits by \$68,671.69, while the current expenses, for the same period, exceeded those of the previous year by \$21,305. This statement goes to confirm, in part, a fact previously brought to the notice of the stockholders, that an increase of business on a railroad does not necessarily involve a corresponding increase of current expenses, where the Company is properly prepared with locomotives, and the requisite number of cars, to meet the business offered. The fixed capital is in the road-bed, and an appropriation or but one-tenth of that amount for an increase of motive power, may more than double or quadruple the capacity of the Company to do the business offered, and at a very inconsiderable augmentation of what may legitimately be charged to current expenses. In the expenditures, however, brought under this head, on the South Carolina Railroad, are included \$21,025 for three new locomotives and extra wheels; \$17,498 for new passenger and burden cars; \$2400 for patents for spark arresters and chilled boxes, and \$775 for extra permanent machinery in the work-shops. If from these various appropriations to permanent objects, and amounting in the aggregate to \$41,698, be deducted \$23,561.50, the amounts expended on similar objects, as shown in the report for 1843, we would have \$18,027 to be deducted from \$21,305, the excess of current expenditures for 1844, which would reduce that sum to \$3278, and show that an increase of 20 per cent, on the gross income of the Road from freight and passengers, involved an increase of but one per cent. on the legitimate current expenditures, and exhibit the encouraging result of 90 per cent. on the nett revenue.

The statements from the Auditor which accompany this report, will exhibit a satisfactory account of the property, the liabilities, and the available assets of the South Carolina Railroad Company, as now consolidated. To the tabular statement, No. 6, the attention of the Stockholders is particularly invited, as exhibiting, on one sheet, a perfect synopsis of the business transactions of the South Carolina Canal and Railroad Company, for each half year from the commencement of operations in the year 1830, to the 1st of January, 1845, including the year 1844, of consolidation with the Louisville, Cincinnati, and Charleston Railroad Company.

This is an interesting paper, exhibiting the number of locomotives in service; the trips and number of miles performed; the income received, and the fluctuations in the trade and travel on the Road, and developing results instructive to those charged with the direction and

management of railways; where *economy of expenditure* and *cheapness of transportation* are so dependent on the proper construction and judicious application of the powers of the locomotive. This is the great desideratum to be attained in all operations where machinery is used, and of vast importance to railroads, as the element on which their triumph over all other conveyances and success must finally rest. These views cannot be stronger illustrated than by comparing from the table, the operations of the *first* with the last half years of 1843 and 1844. In the first half years, 15 locomotives in service, made 2,036 arrivals and departures; ran over 319,968 miles; transported 130,366 bales of cotton and 48,722 passengers, and realized in money, including the freight on merchandize and the mails, \$460,-057.35. In the last halves of the same years 16 locomotives in service, making 1,904 arrivals and departures, and running 304,752 miles; 132 arrivals and departures, and 14,216 miles less than in the first halves of the same years; transported 184,319 bales of cotton, 43,164 passengers, and realized for the Road \$515,743.85 in money; shewing that with but one additional engine, and less *miles* and *trips* performed, an increase of 53,953 bales of cotton—a decrease of 5558 in the number of passengers, and an augmentation in the moneyed receipts of \$55,686.50. The decrease in the passengers is explained by the facts of two Methodist Camp Meetings in the spring of 1844, at Ladson's Station and the Cypress, and at which it was estimated there were between 5 and 6000 attendants. Another comparison between the years 1842 and 1844, will serve to illustrate the powers and advantages of the larger class of locomotives, six (6) of which have been added the last two years, to the 2d and 3d class engines previously used on the Road. In the year 1842, the year previous to the consolidation of the two Roads, 14 engines in service made 1809 arrivals and departures; performed 286,995 miles; transported 92,336 bales of cotton and 33,925 passengers, and realized in money for the Road \$408,704.87.

In 1844, 17 locomotives are returned as having made 1964 arrivals and departures, run over 310,812 miles, and transported 186,638 bales of cotton and 54,146 passengers—and realized on the whole, including freight on merchandise and the mail, \$532,869.85, shewing with but three additional engines, an increase of 94,302 bales of cotton, 20,221 of passengers, and \$124,164.98 on the gross income, being at the rate of 100 per cent. on produce, 60 per cent. on the number of passengers, and 31 per cent. on the moneyed receipts. The increase on the moneyed receipts does not bear the same proportion to the increase on the quantity of the freight and number of passengers, and which is to be explained by the modification and reduction made on the rates of freight and passage in 1844. In 1842, the fare for passengers was 18 per cent.; on merchandise, from 12½ to 15 per cent.; and on cotton and weight freight, from 30 to 40 per cent. higher than it was in 1844. At the same rate of freights, provided the same amount of business could have been commanded, the increase on the moneyed receipts, on the transportation performed, would have been full 25 per cent. greater.

The subject of the rates for freight and passage on railroads, must be relative, and be governed by the quantity of business and number of passengers offering, and the competition with other common carriers. To meet a competition which is daily increasing from the number of new Roads in the United States, which have been constructed; and from the improvements in, and new application of, machinery, to steam navigation, it will be necessary to be governed in some degree by the fares established by other common carriers, contending for the same business; or forfeit the claim of the South Carolina Road to a fair participation in it. By this policy, in regulating a Tariff for Freight and Passengers, your Directors have been governed; and they will continue, in the future, as they have in the past, to bestow on this, as on all other subjects, affecting the interests of this Company, the consideration of their most matured judgments.

With these Tables, is one shewing the number of Grades and their lengths; with the lengths of the different curves and straight lines; the distance between the different stations and depots, and their relative elevations; with the elevations of each point above tide water; on the road between Branchville and Columbia. A similar table we have in preparation for the Charleston and Hamburg Road, which has not yet been perfected, for the want of the necessary documents.

The Report of Mr. G. B. Lythgoe, the Superintendent of the Road, shews that under his vigilant supervision, the track and embankments have been preserved in the same good condition represented to be in the previous year. He states, however, what has been long since apprehended, that the heads of the piles, sustaining the cross-ties and superstructure, on the Hamburg Road, are beginning to exhibit decay, and to obviate this defect, it will become necessary to lay mud sills on the top of the piles. That, if this work is commenced immediately, its expense may be distributed through consecutive years; and therefore recommends that twenty miles of the road, for the next four years, be so improved, which will probably involve an increased expense for timber and labor, of \$300 per month.

On the Columbia road, which is generally in good order, it was found indispensable to renew some of the cross-ties, between Orangeburg and Branchville, the last spring and summer. As it is but four years and six months since that section of the road was finished, that fact goes to confirm the past convictions that the durability of pine timber at the South, exposed as the cross-ties are on the Columbia road, on the surface and but half covered with earth, cannot be depended on to exceed an average of five years; and that all timbered superstructures of roads, in Southern latitudes, will require renewal within that period, or one-fifth each year for the whole extent. By way of experiment, six miles of the Columbia road was constructed of Cypress ties; but sufficient time has not yet elapsed to test their superior durability over pine, or their greater economy in the higher price. The durability of timber is a subject of deep interest to Railroad Companies: particularly as timber superstructures are beginning to claim a preference to those made of materials of a less yielding or elastic character; and has engaged the attention for many years of

the successive Board of Directors of the South Carolina Canal and Railroad Company. The process of kyanizing, which was tested to a small extent, seemed to act favorably on the fibres of the wood to which it was applied; but the problem yet remains unsolved, whether the additional durability imparted is compensated by the extra expense incurred. The experiment with the mineral process, recommended by Dr. Earle, and for which an appropriation was made by the South Carolina Canal and Railroad Company, Mr. Lythgoe thus remarks:—"I regret to say, the process of Earlizing sap timber will not answer the purpose intended: as we are now compelled to take all we have used out of the road as soon as we possibly can, in consequence of its having become so soft and decayed as to allow the iron to embed into it, thereby injuring the iron to a considerable extent." The report of Mr. Lythgoe represents that the expense of the maintenance of way on the Hamburg road the last year, has been \$293 per mile; which including the sum of \$828 expended in ditching and on embankment, equal to an average of \$6 per mile, makes the whole sum \$299 per mile. The expense of maintenance of way on the Columbia branch was but \$138 per mile, including \$424 incurred in ditching and embankments, makes \$144.28 per mile. The difference in the expense per mile on the two roads, is explained by the different plan of construction, and the different ages of the roads; the timber, with the exception of one short section, on the Columbia road, not having had time yet to manifest decay or require renewal. The expense of maintenance of way on the Hamburg road, if preserved at the above standard, \$299 per mile, is as low, probably, as it can be reduced to; while some addition to the amount incurred for the same objects on the Columbia branch will become necessary, as the age of the road and the business on it increases.

The Report of Mr. Darrel, Master of the Workshops, presents the state and condition of the motive power owned by the Company: and a favorable statement of the quantity of work done in the Finishing and Smith-shops and Foundry, and on the locomotives rebuilding and repairing, the last year. From his report, it appears he received from his predecessor, as Master of the Shops, 23 locomotives of the 2d and 3d class; enumerating all which bore the name in the yard, and one new boiler finished. Of these locomotives, many of which had been in the service of the South Carolina Canal and Railroad Company from its commencement of business in the years '31 and '32, 4 are stated to have been in good order; 7 defective, and somewhat disabled, but performing road service; 6 repairing and rebuilding, and 3 condemned; since which, 3 others of those disabled, have run their career, and been condemned, or laid up in ordinary for summer examination, and see to what profitable purposes they, or parts of them, can be applied. To the above locomotives have been added the last two years, 6 of Baldwin and Whitney's six wheel connected locomotives of the 2d class. Deducting the 6 which have been condemned, or laid up in ordinary, and one (1) that is rebuilding, 22 may be considered as in a condition to be made fit for road duty, under occasional repairs; from 16 to 17 of which have been

kept in active service during the year ending 31st December, 1844, which is a very large proportion. It has been considered good policy, and particularly by those well acquainted with the delicate mechanism of the locomotive, so easily deranged, that Companies should own double the number that they can keep constantly and profitably employed: and the best regulated English and American roads preserve very nearly this proportion. Where the opposite policy is pursued, locomotives often suffer, are soon destroyed, and rendered worthless, from the want of timely and effectual reparation. When the business of the road presses, and in no modes of transportation are the alternations from one extreme to the other so frequent as on railways, temporary expedients, where there is a deficiency for the time of power, must be resorted to; and engines, though slightly disabled and easily repaired, are too frequently forced, from necessity, on another trip, to their more permanent injury, if not ruin; or taken in shop late at night, hastily overhauled, and rudely repaired by the light of the torch, so as to be replaced on the road, for service, in time next morning. It is difficult, under such arrangements, to preserve the locomotives in the best condition for profitable use; or to conduct the operations at the workshops, and regulate the transportation on the road with economy and satisfaction.

The Joint Report of the General Agent, Mr. King, and the Agent of Transportation, Mr. Hacker, show that this Company now have in service, for the very large and increased business which has devolved on it, but 18 passenger and baggage cars, and 283 freight cars; 147 of which are of four wheels, with canvass sides, and of inconsiderable burden: the whole of them not more than equal to accommodate the loads for two engines. Of these, one 8 wheel passenger, one 8 wheel baggage, thirty-two 8 wheel box, and fourteen 8 wheel platform cars, have been added during the year 1844, and at a cost to the company for wood work of \$7020, and for wheels and axles, as reported by Master of Workshops, \$10,478—making for the whole, \$17,498. Both of these officers, and whose duties and responsibilities afford them the best opportunity of forming correct opinions, concur in the necessity of an additional number of passenger, baggage, and burden cars, to do the business of the road to the best advantage, with punctuality, and to the satisfaction of travelers and shippers. The want of more suitable and more enlarged accommodations at the depots at Charleston, Hamburg and Columbia, is the more strongly enforced by their testimony; and while these subjects have engaged the attention of the Board of Directors, whose term of service now expires, they cannot too strongly impress its importance on those who, by your selection, may be their successors in office for the present year. It may involve considerable expenditure in the first instance; but the interests of the Company and its security and protection from probable heavy loss, and its ability, through active agents, to discharge with exactness and despatch its varied responsibilities, as a common carrier, to all who travel and transport on the road, strongly recommend the necessity of more suitable, more commodious, and more permanent buildings, at the workshops, and

the three important depots at Charleston, Hamburg, and Columbia, than at present exist.

At the last Session of the Legislature, application was made by many of the citizens of Sumter and Kershaw, for aid in the form of a subscription, to assist in extending the South Carolina Railroad, under a provision in its charter, to Camden. That body declined participating in the enterprise as a Stockholder, but responded favorably to the application, so far as to authorize this Company to become Joint Stockholders with the citizens of that section of country through which the road to Camden was to pass, and as a motive for this Company so to co-operate in the work, an act was passed authorizing the funding, at five per cent. interest, and on time, of a debt which accrued under the law reducing the stock in the Louisville, Cincinnati, and Charleston Railroad Company, and which now stands to the credit of the State in the books of said Company. A reference to the act will explain more satisfactorily its provisions. To enable the Stockholders to act more advisedly on the subject, and at the particular solicitation of many of the citizens of Sumter and Kershaw, who had expressed an interest in the enterprise, a preliminary survey was ordered by the Board of Directors. Mr. Mac Rae, favorably known to the Stockholders, was charged with the service, and his report and approximate estimate of the probable cost of the work, is herewith respectfully submitted. His estimate is based on two plans of superstructure. In the one, where a wooden stringer and light iron rail is used, the cost is estimated at \$450,000. In the other, where a heavier T rail is used, and the plan is made to conform to that of the Columbia road, the cost is put down at \$540,696. In both estimates the present specific duty on rail iron at \$25 a ton is included—amounting to \$60,000 on the first, and \$90,000 on the last estimate. If the tax is remitted, or reduced to a revenue standard, there will be a corresponding decrease in the probable cost of the road.

The Board of Directors, with much satisfaction, now report to the Stockholders, the extension of the Georgia Railroad to Covington, twenty-five miles beyond its late terminus at Madison; and that the reported progress in the section above, removes all doubts as to the road being completed to Whitehall, the point of junction with the Western and Atlantic Railroad, by September or October next, and in time for the opening of the fall business. At the same period, such is the progress now making with the work on the Western and Atlantic Railroad, that that road will be completed and in operation to the Oostanauly, eighty-four miles beyond Whitehall, and within fifty-six miles of the Tennessee river, at Chatanouga, and seventeen of the Coosa, at Rome.

Within the last twelve months the condition of the West Point and Montgomery Railroad has been greatly improved, and active measures taken to extend it some five or six miles east of Chehaw. At the late session of the Legislature of Alabama, the 2 per cent. land fund, amounting to about \$240,000, was appropriated in equal proportions, and on most favorable terms, to the completion of the West Point and Montgomery road to the Chattahoochee, and to that of a

newly projected road connecting the Coosa, by Will's Creek Valley and the Sand Mountain, with Gunter's Landing on the 'Tennessee. All these events go to approve the late action and policy of a majority of your Board of Directors in co-operating to the extent of their ability with the Georgia Railroad and Banking Company, and the West Point and Montgomery Railroad Company, for the completion of their respective enterprises, estimating them as important links, in the great chain of railroad intercommunication connecting the extreme Eastern with the most South-western extremities of the Union—an enterprise in which not only this Company, but the City of Charleston and State of South Carolina, cannot but feel the deepest interest, and acknowledge the important influence its completion must have on the prosperity of each.

All of which is respectfully submitted by

JAMES GADSDEN, *President.*

To be Continued.

### *Uniformity of Gage.*

No man can doubt the desirableness of one uniform gage, if at any reasonable cost it could be attained. Mr. Cobden has, therefore, done wisely in bringing it forward, even now late as it is.

Great difference of opinion existed at first among engineers as to what should be the proper gage. Most of them were of opinion that the present is too narrow, and perhaps if the whole was to be done over again, we should have it something wider.

The reasons for a wider gage were chiefly two—one, that the present gage would be dangerous at high speeds, and the other, that it did not afford scope for that powerful machinery in locomotives necessary for attaining very high velocities. Greater research and experience have exploded the first, and along with it, one of the arguments of Mr. Brunel for his broad gage. He asserted, that by increasing the gage he should be able to use higher wheels on the carriages and engines, and that these higher wheels on the carriages would work with less friction, and, therefore, more economy. The less friction with high wheels, we at first opposed, as being contrary to the results of experiment, which showed that slipping friction is independent of velocity, and the rolling friction on railways is insignificant; and experience has taught Mr. Brunel that we were right, for he has abandoned his high wheels for carriages.

In respect of the engines, this fact is enough. There are, or were, about his Company's premises, engines with ten feet wheels, which cost some £ 30,000 or £ 40,000, and have never been used, for one very good and—to all other men's minds except Mr. Brunel's, until he tried them—very obvious reason, namely, that they did not possess the power to work. They are, of course, laid aside, and the Company have gradually come down to more reasonable dimensions, we believe from six or six and a half to seven feet wheels.

The second reason, that is, that the narrow gage does not afford room for machinery competent to compass high velocities, was no

doubt good at the time, but by a better arrangement and larger boilers, Stephenson has got over the difficulty.

To understand this point, the reader should be informed, that the power of an engine to draw great loads at moderate velocities, and small loads at high velocities, depends on two very different qualities. One is the weight of the engine combined with cylinders large enough to use it, and a boiler to supply steam moderately fast. Hence, heavy engines, with coupled wheels, are generally required to exhaust all the weight of the engine. The other depends not so much on the weight of the engine—which is seldom if ever taxed to the full or a fourth—as on the power of the boiler to generate steam rapidly. This, Mr. Stephenson's new engine, combined with an expansive apparatus, does effectually, and appears, by an improvement lately introduced of double valves one above the other, with an advance of eccentric to close the parts earlier, to be capable of still greater improvement. In these engines, it is not great statical power, but an abundant supply, and a proper husbanding, of steam, that are wanting. In short, for heavy loads weight of engine is the principal element, but for high speeds, a rapid supply of steam. This, at first, Brunel maintained could only be accomplished by more room for the boiler, that is, by a wider gage. Mr. Robert Stephenson, however, has cut this reason away, by increasing the length of the boiler, and generating more steam with the same fuel. The simplification which he at the same time gave to the working gear, and the improvements which have lately been made in the valves, have at length furnished us with the means of economizing this steam so much as, in fact, to give us much more than we want.

Both Brunel's reasons, therefore, for the broad gage, whatever plausibility they had in the first instance, now no longer exist.

If, then, there be any change of gage, reason tells us that it should be from the broad to the narrow gage. Not only is it the gage containing some four or five times the number of miles in operation, but the change could be made at incomparably less cost, and without any danger to the public or delay in the traffic. Another rail within each of the outer rails would do it as far as the road is concerned; for which the road is prepared, and only wants the rails to be laid down. The cost would be under £80,000. In a month or less after the materials are procured, the whole may be done with a proper force. All the tunnels, all the cuttings, bridges and embankments, which do for the broad gage, will equally do for the narrow. But, as it was well observed in the House, and is stated by one of our correspondents, if the converse is to be done—the narrow turned into the broad—the whole works must be changed. More land must be bought; the bridges, tunnels, embankments and cuttings, must all be widened. At a moderate estimate, the cost of the change would be from a fourth to a third of the entire cost of the line. Twenty millions would not do it; and as to the time required, no one could calculate it. Of the danger, too, attending widening tunnels, we have had a specimen by the falling in of the tunnel while it was widening on the Newcas-

tle and Carlisle Railway. To talk of changing the narrow to the broad gage, would be very little short of insanity.

That a change would be desirable to one uniform gage is too evident for discussion. We can only say that we shall be glad to see it for the convenience of the public principally, but also to prevent these unseemly strifes which we have lately witnessed between the two gages; and we wish, therefore, every success to Mr. Cobden's motion on Wednesday evening, which we are glad to see was well received by the House.

A Commission is to be appointed for the purpose. We only hope it will be a judicious one.

Railway Mag.

### *Projected Railways before Parliament.*

A very curious return has just been laid before Parliament, in relation to projected railways now before Parliament. It thence appears that the railways, of which plans and sections have been deposited with the Railway Department of the Board of Trade, amount, in length, for Great Britain and Ireland, to no less than 8080 miles, being thus nearly 24 times the length of England itself! The following are the proportions of the lines proposed to be made in the different countries of the United Kingdom: England has, as her share of these projected railways, 6086 miles and a fraction; Scotland has about  $\frac{1}{10}$  the quantity—the proposed lines in that country only extending to 595 miles; Ireland, however, is far ahead of Caledonia in this respect, and the sister isle has no fewer than 1401 miles of railway projected to be laid down therein. These statements have regard only to the projected lines which are this session before Parliament for consideration. They do not include any portion of the numerous lines that have since and are weekly, or rather daily, being brought forward, but merely give the length of the railways, plans for which were deposited with the Board of Trade towards the close of last year, in accordance with the directions issued by the Railway Department of that Board.

Globe.

### *Labor Provided by Railways.*

That some idea may be formed of the immense stimulus the trade of the country would derive from the formation of the contemplated railways, it is only necessary to state that were 2000 miles of the projected railways to be constructed, it would give employment to 500,000 laborers and 40,000 horses for the next four years.

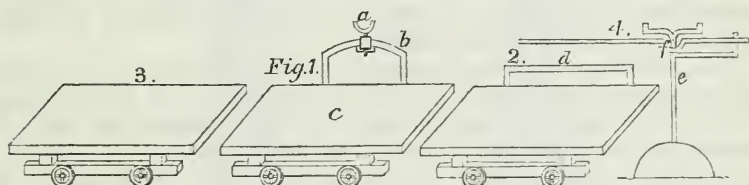
Railway Mag.

## ENGLISH PATENTS.

*Specification of a Patent granted to ALEXANDER EWING, of the county of Dumbarton, Scotland, for certain improvements in the manufacture of crown-glass. [Sealed 15th August, 1844.]*

In the ordinary mode of manufacturing crown-glass, the metal is liable to be unequal in substance from rim to rim, or in particular places; to produce greater equality of thickness or substance in the tables of crown-glass, is the object of this invention.

The improvements come into operation when the workman, called the gatherer, has formed the piece of glass, or metal, on the "hand-pointing, or gatherer's, marver," and when the piece, so formed, is about to be perforated by the blower behind, or during the operation of perforating, or immediately after it. At this stage of the process, the gatherer is to apply that part of the gathering which is near the tube, or pipe, to the implement, *a*, made of iron, or other metal, (termed a cutter, and represented at fig. 1,) bolted to the standard, *b*,



at the back of the gatherer's marver, *c*; and then the piece being turned round, an incision is made by the implement, which displaces the metal from the nose of the pipe into the shoulder of the gathering, insuring strong shoulders: the rim may be thus brought to any consistence; and, after expansion, an equality of substance of the table, generally, will be the result; and, owing to such uniformity, a more effectual standing in the annealing arches can be depended upon. The patentee does not confine himself to the form of the implement, *a*; he sometimes employs, instead of it, a circular bar of iron, or other metal, *d*, fig. 2, attached to the marver; and sometimes he uses the edge of the common marver, fig. 3, for producing the same effect.

At the time of perforation, or before, or immediately after that operation, the glass is carried, as usual, to the "pattison hole," and, a heat being taken, it is marvered on the blower's marver; it is then returned to the pattison hole, and, when sufficiently heated, is taken by the workman to the stake, or standard, *e*, fig. 4, in order to increase the size of the globe. To the upper part of the standard, *e*, a cutter, *f*, is secured, by a nut and screw, in such a manner as to admit of its being raised or lowered at pleasure; and this cutter is applied to the nose, or neck, of the piece, to prevent it from swelling at the nose, and to effect a greater disunion of the piece from the pipe. The piece is then taken to the "bottoming hole," by the blower, and heated, and blown to the size desired; after which it is taken to the

“casher-box;” then to the “nose-hole;” and lastly to the annealing arch, or kiln.”

The patentee does not confine himself to the details of the apparatus used, as above described; provided the peculiar character of the invention be retained. He claims, Firstly,—the mode of operating in the manufacture of crown-glass described in respect to fig 1. Secondly,—the mode of operating in the manufacture of crown-glass described in respect to fig. 4.—*Inrolled February, 1845.*

Lond. Jour. Arts and Sci.

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*Specification of a Patent granted to THOMAS HEATON, county of Lancaster, for his invention of certain improvements in hydraulic machinery, which are also applicable to raising other liquids.*—[Sealed 15th August, 1844.]

This invention applies particularly to hydraulic machinery, such as pumps or engines, employed for raising or forcing water from mines, pits, &c.; but it is equally applicable, in principle, to manufacturing and domestic purposes, and especially for ships' uses, fire-extinguishing engines, and similar purposes, where water or other fluids are required to be displaced.

The first feature of novelty consists in the application of a hollow ram, or plunger, which may be of an equal area with the working barrel, either more or less, engaged either in connexion with a common, or the improved, bucket, hereafter described, in place of the ordinary pump-rod, or connecting-rod. This application of a hollow ram, or plunger, to pumps, or other hydraulic machinery, for raising and forcing water and other fluids, is for the purpose of displacing a considerable quantity of the volume of fluid above the bucket, as the bucket descends; and by thus removing the weight of fluid above the bucket, greatly economizing the power required, and reducing the strain upon the working machinery of the primary moving power. It will also be evident, that as the object of this ram is to displace a large quantity of water, a wooden ram, of a similar diameter, might be adapted in lieu thereof.

Secondly,—these improvements in hydraulic machinery consist in the novel application, or employment, of a double set of valves to the clacks and buckets of pumps, for certain useful purposes hereafter described. And thirdly,—the invention consists in a particular method of packing either the bucket, the working-barrel, or other parts of pumps, by the novel application of a material now well known as “Jeffery’s marine glue;” the use of which for such purposes is particularly advantageous, whether it be employed alone, or combined with filings of brass or other metal, layers of leather, or other substances.

Fig. 1 represents a sectional elevation of the working parts of a pump, in connexion with pump-trees, above and below, and supposed to be employed for raising water from a mine, well, cistern, or other reservoir; fig. 2 is a similar sectional view, but exhibiting some modifications in the internal arrangement; fig. 3 is a transverse section, taken through the pump, at the line A, B, in fig. 1, showing a plan view of the top pair of valves of the bucket and the stuffing box; and

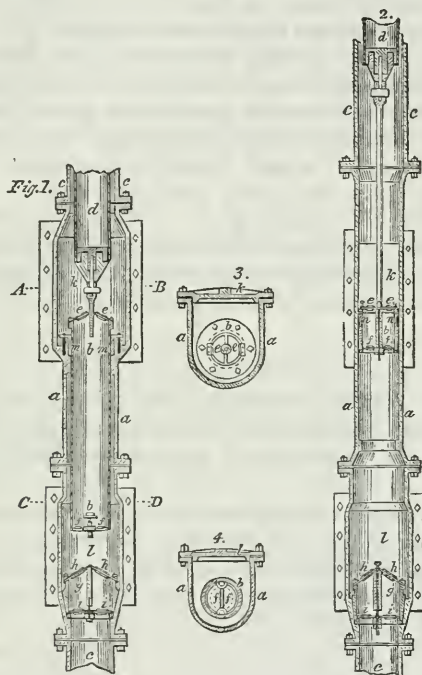


fig. 4 is a similar view, taken through the line c, d, shewing the bottom pair of valves of the bucket. *a, a*, is the working-barrel of the pump; *b, b*, the bucket; and *c, c, c*, the pump-trees, extending upwards and downwards from the working-barrel; *d, d*, is the hollow ram, which extends upwards from the bucket, (in place of the ordinary connecting-rod) to the top of the pump-trees; the upper end of this ram being closed, a cylindrical air-vessel, occupying a very considerable portion of the area above the bucket, is formed, and a corresponding volume and weight of fluid is consequently displaced. It will be observed, that the bucket, *b, b*, is furnished with two sets of valves, or bucket-lids, *e, e*, and *f, f*, so that, should one of the valves be prevented from closing by a piece of wood, a stone, or any other substance, (which is very liable to be the case in working from a bad bottom,) the other valve may close, and raise the water, while the down stroke of the bucket will be sure to clear away the impediment. The clack-piece, *g, g*, is also furnished with two sets of valves, or lids, *h, h*, and *i, i*, for the same purpose; which clack and bucket-lids

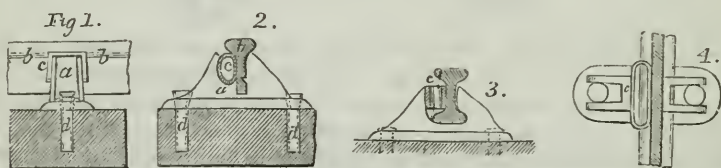
may either be hung upon hinges, as shewn in the drawing, or be made to rise and fall separately upon spindles or slides. It will be observed, that doors or plates are provided, for the purpose of readily obtaining access to both the buckets and the clacks; thus admitting of their being cleaned or put in order, as occasion may require. *k, k*, are the bucket-doors, and *l, l*, the clack-doors.

The peculiar method of packing hydraulic machinery is represented in two separate modifications, at figs. 1 and 2; that in the former being enclosed by a glandular ring, in the concentric groove, *m, m, m*, (the pump-barrel thus completely surrounding the bucket, which, in this case, is lengthened, to allow of such mode of packing;) and that in fig. 2 being shewn in a reverse position, or placed in the groove, *n, n*, turned in the bucket, and thus forming the packing between it and the working-barrel. In both instances the spaces between the grooves, *m* and *n*, are to be tightly packed, either in the common way or with "Jeffery's marine glue." This composition, the patentee states, will be found most efficient for such purposes; it consists of caoutchouc dissolved in conjunction with shellac, and is highly elastic, and quite impervious to the passage of water.—[Inrolled February, 1845.]

Ibid.

*Specification of a Patent granted to WILLIAM HENRY BARLOW, of Leicester, for improvements in the construction of keys, wedges, or fastenings, for engineering purposes.*—[Sealed 6th March, 1844.]

The novelty of this invention consists in substituting, in place of solid metal, or wooden, wedges, or keys, now employed for engineering purposes, a peculiar construction of fastening, made of hollow metal, by which means a degree of elasticity is obtained, together with lightness and strength.



Figs. 1 and 2 are front and end views of a railway chair, shewing the rail fixed in its seat by means of the hollow wedge. *a*, is the chair; *b*, the rail; and *c*, the hollow wedge (made of wrought iron) which is driven between the rail and the chair. This wedge is made into a perfect tube, by welding its parallel edges together, and, if thought necessary, one side of the tube may be flattened to fit the side of the rail. The patentee, although he prefers the wedges, or keys, to be welded, (a less thickness of metal being in that case required to give the necessary strength and elasticity,) states that they may be employed without welding, but that the edges should abut against each other.

Another mode of constructing hollow wedges, or keys, for securing

the rails of railways, is shewn at *c*, figs. 3 and 4: the wedge in this case is similar to a link of a chain.

Hollow wedges formed like a tube are also employed for securing the chairs to their sleepers, as represented at *d*, *d*, figs. 1 and 2: tubes, either welded or not, may be used for this purpose, as shewn at fig. 5. The patentee states that, although he has shewn the exact form of wedges, keys, or fastenings, which he has used, he does not confine himself to these particular forms; but he claims the mode of making keys, wedges, or fastenings, for securing railway bars in the chairs, and securing railway chairs to the sleepers, or blocks, and for other engineering purposes, by forming them of hollow metal, as above described.—[*Inrolled September, 1844.*]

*Ibid.*

*Specification of a Patent granted to FREDERICK RANSOME, of Ipswich, for improvements in the manufacture of artificial stone for grinding and other purposes.*—[*Scaled 22d October, 1844.*]

This invention consists, firstly, in manufacturing artificial stone, by cementing broken or pulverized stone, sand, or earthy or metallic matters, with a solution of silica; and secondly, in subjecting the artificial stone, formed in this manner, to hydraulic or other mechanical pressure, in moulds.

The solution of silica, or siliceous cement, is made, by preference, in the following manner; but the patentee does not confine himself to this mode of preparing it:—100 lbs. of crystalized carbonate of soda are dissolved in 50 gallons of water, and the soda is rendered caustic by the addition of lime; or, instead of carbonate of soda, 50 lbs. of carbonate of potash are dissolved in the requisite quantity of water, and the potash rendered caustic, as above mentioned. The caustic alkaline solution is reduced, by heat, to 20 or 25 gallons; it is then put into an iron boiler, or digester, with 100 lbs. of finely broken flints, or other siliceous substance, and the mixture is heated, during ten or twelve hours, up to a pressure of about 60 lbs. to the square inch, (being frequently stirred during that period;) after which it is removed from the digester, and passed through a sieve, to separate any undissolved stone from it. The cement is now ready for use; or may be brought to any required consistence by the admixture of sand, or finely powdered flints; or it may be thinned by the addition of water.

Mill-stones are made, according to this invention, by mixing together one part of siliceous cement, one part of powdered flint, or powdered pipe-clay, and three or four parts of fragments of burr, or other suitable stone; this compound is subjected to mechanical pressure, in iron moulds, and, after being removed therefrom, is allowed to dry, at the ordinary temperature of the atmosphere, for twenty-four hours; it is then placed in an oven, or drying-room, where the temperature is gradually raised to that of boiling water, and the stone

is thus effectually dried. When artificial stone, for other purposes, is to be manufactured, a mixture is made of granite, common sand, or fragments of any siliceous or other hard stone or substance, with from one-fourth to one-sixth of the siliceous cement; and it is treated in the same way as that above described.

By reducing the stone or other material to very fine particles, previous to adding the siliceous cement thereto, more or less fluid mixtures may be produced, for coating walls or other surfaces.

The patentee claims, Firstly, the mode of manufacturing artificial stone, for grinding or other purposes, by cementing broken or pulverized stone, sand, or earthy or metallic matters, with a solution of silica. And, Secondly, subjecting artificial stone, produced by the aid of a solution of silica with broken or pulverized stone, sand, or earthy or metallic matters, to hydraulic or other mechanical pressure, in moulds.—[*Inrolled April, 1845.*]

*Ibid.*

## MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Construction and Proper Proportions of Boilers for the Generation of Steam.* By ANDREW MURRAY, Assoc. Inst. C. E.

(Read at a meeting of the Institution of Civil Engineers.)

This paper commences by investigating the quantity of air chemically required for the perfect combustion of a given quantity of coal, of the quality commonly used for steam purposes. The amount of air to each pound of coal is stated to be 150.35 cubic feet, of which 44.64 cubic feet are required for the various carburetted hydrogen gases given off, and 105.71 for the solid carbon. The practical utility, however, of this knowledge, is much impaired by the circumstance that combustion ceases even in pure oxygen, and much more in air, before the whole of the oxygen present has entered into the new chemical combinations required. It is also known, that carbonic acid gas exerts a positive influence in checking combustion, as a candle will not burn in a mixture composed of four measures of air and one measure of carbonic acid gas. Large quantities of this gas being generated by the combustion of the solid carbon on the grate, and being necessarily mechanically mixed with the inflammable gases as they rise, the quantity of air required for their subsequent combustion must, on this account, be increased to a very large extent. The whole of the air thus supplied in excess, must be heated to a very high temperature, before any combustion can take place, and the loss of the heat thus absorbed must be taken into account in calculating the ultimate economy of igniting these gases.

The form of furnace now in general use, in which the fuel is spread over a large surface of fire-bar, has not been subject, in so far as effects the supply of air through the bars, to much alteration, amongst the many patents and proposals which have been made for the more complete combustion of coal. The point most open to change in the common furnace, is the width between the bars; and as it is desira-

ble to have the supply of air to the furnace as abundant as possible, it should be made as large as can be done without causing waste, by allowing the coal to fall through into the ash-pit. A greater number of thin bars is thus to be preferred to a smaller number of broad or thick bars; indeed, to such an extent is this carried in France, where coal is more valuable than in this country, and the chemistry of the subject perhaps more generally understood, that the bars are made not more than half an inch thick, the necessary strength being obtained by making them four inches deep. With coke or wood, which cannot fall through the bars and be wasted, in the same way as coal, the space is always made much wider, and with great advantage; so much so with coke, as to have led to the opinion that a given quantity of coke would produce as much heat by its combustion as the coal from which it was made. Any grounds for such an opinion could only have arisen from the combustion of the coal having been so imperfect, that not only had the whole of the gases passed off unconsumed, but even a large portion of the solid carbon must have been allowed to escape in the form of carbonic oxide, without having generated its due amount of heat, and been converted into carbonic acid gas.

In the combustion of coke, or of the solid portion of coal, as left in an incandescent state on the fire-bars of a common furnace, after the volatile gases have passed off, the amount of heat generated by the whole of the carbon, uniting at once with its full amount of oxygen, will be the same as what would be generated by its combination, first, with a smaller quantity of oxygen, forming carbonic oxide; and subsequently, by the ignition of this gas, by its combination with the further quantity of oxygen required to turn it into carbonic acid gas.

As some portion of the carbon is always converted into carbonic acid gas in the furnace, it follows, that the air for the ignition of any carbonic acid there formed, and allowed to pass into the flues, must be greatly in excess of the quantity chemically required; and the whole of this excess must be raised to the temperature of the other gases, with which it will be mingled. The superior economy, therefore, of at once converting the whole of the carbon into carbonic acid gas, is apparent; and there is no doubt but that this very desirable result may be obtained nearly to the full extent, by due care in the formation and subsequent management of the furnace.

The best mode of supplying air to the other inflammable gases resulting from the combustion of bituminous coal, which are composed of hydrogen and carbon, and which will be treated of under the common name of carburetted hydrogen, has been a matter of much controversy, and been the subject of many patents. The mode proposed by the greater number of the patentees is, to admit the air immediately behind the furnace, at the back of what is termed the bridge. A bridge does not exist in every case; but where it does exist, it is generally in the form of a wall or obstruction right across the back of the furnace; often placed there for no other purpose than to prevent the fire from being pushed back into the flue. The whole

of the products of combustion, as formed in the furnace, necessarily pass over this bridge, before entering the flue. The additional air is sometimes heated, previously to its being admitted to the gases, after they have left the furnace, and the manner in which it is supplied varies exceedingly; one party advocating its admission in a long thin film, another through a great number of small orifices, and others again attach less importance to the manner of its admission, so that it is only admitted in sufficient quantity. All these plans proceed upon the supposition that large quantities of inflammable gas pass off from the furnace, and as none of them directly affect the operations going on within the furnace itself, the gases which are actually given off would be the same until they pass over the bridge, whichever plan might be adopted.

These plans must all cease to be necessary or useful, if a furnace can be so constructed, and the combustion of the coal in it so managed, that a very small proportion only of uncombined inflammable gases would pass off, as in this case no economy would result from their combustion, owing to the large excess of air which must be supplied and heated as before explained.

The admission of a large quantity of air into the flue, at a distance from the furnace, though advocated by some authorities, cannot be advantageous, unless in extreme cases, when the temperature in the flue is very high, and where the combustion in the furnace has been more than usually imperfect.

As the carburetted hydrogen gases are generated rapidly, on the application of heat to the coal, and are in themselves much lighter than the carbonic acid gas, or the nitrogen gas, formed at the same time, it is sometimes assumed that they rise nearly unmixed to the top of the space over the furnace, and thence it is considered more advantageous to supply the air at this place than in the flue. The cooling effect of air, if admitted into the furnace, has been stated to be more injurious than if admitted into the flue; but the correctness of this statement may be doubted, especially if the gases be unmixed, as this would render a much less quantity of air sufficient.

The bars in this case should be placed at least two and a half feet or three feet below the boiler, or the crown of the furnace, to allow the principle to be more fully carried out. An increase of space over the bars to this extent has always been found to be advantageous, and ought to be particularly attended to. The system of admitting the air to the gases in a subdivided form, in whatever part of the boiler the admission of it may take place, is very efficacious in procuring a thorough and speedy mixture of the particles. It has been very extensively and successfully introduced by Mr. C. W. Williams in supplying air behind the bridge of the furnace.

An opinion is entertained that a sufficient supply of air for the gases may be obtained through the fire-bars; and it is obvious that a partial supply, at least, may be obtained in this manner, by a judicious management of the fire. This may be effected by keeping the fires thin and open, feeding by small quantities at a time, or by a system of coking the coal, allowing the combustion of it to be slow at first,

by which means the coal is formed into masses of coke, between which the air has a passage. The air which passes through is not vitiated further than in being mechanically mixed with the carbonic acid and nitrogen gases, caused by the combustion of the coal on the bars.

The perfect combustion of the whole ingredients of coal being entirely dependent, chemically considered, on the supply of the due quantity of atmospheric air, it is evident that the velocity with which the air flows into the fire will materially affect the result. According as this velocity is greater or less, so in proportion must the quantity of coal that is to be consumed on a given area of grate be increased or diminished, and there is no limit to the quantity that may be so consumed, beyond the difficulty of supplying the air sufficiently rapid. The various circumstances which affect the velocity of the entering air, have placed this question, as yet, completely beyond the reach of theory, so that practical experiments must be taken as the only guide, in determining what quantity of air can be made to enter into a given furnace, and, consequently, what amount of coal can be properly consumed in a given time.

Mr. Parkes has stated, as the result of a long series of experiments made by him, (*vide Trans. Inst. C. E.*, vol. iii.,) that the rate of combustion should not exceed seven pounds per superficial foot of grate bar per hour, and that this quantity may with advantage be reduced as low as four pounds, or even three pounds. General experience would tend to prove that these latter quantities are unnecessarily low, and can only be advantageous when the arrangements for supplying the air, or for carrying off the products of combustion, are defective or inefficient. It is evident that if the area of any part of the passage, for either of these currents, be too limited, the velocity at this contracted spot cannot rise higher than is due to the weight of the ascending column of heated gases in the chimney. The quantity passing through is therefore diminished in proportion as the area is limited; and a good draught at a particular place, as at the bridge of a boiler, may here be quite compatible with an insufficient supply of air, and imperfect combustion of the coal. The draught in every other part of the flues is, at the same time, rendered slow and languid, and deposition of soot takes place in them. This fault is apparent in a great number of boilers at present in use, and in some cases, especially in tubular boilers, it is attended with very injurious results, by stopping up the tubes, and decreasing the amount of heating surface to such an extent, as to render the boilers incapable of generating the required amount of steam.

The furnaces of the boilers in general use in Cornwall, are upon the common principle of construction, and as in them it is not usual to apply any of the peculiar patented arrangements for the supply of air to the gases, behind the bridge, it follows, either that these gases are not consumed, or that they are consumed by air admitted through the bars. In the Cornish system of raising steam, slow combustion is adopted in its fullest extent; the fires are kept thin and open, the fuel is supplied in small quantities and frequently, and it is well

spread over the whole surface. As the result is highly favorable in the economy of fuel, it may be presumed that the combustion of the gases, as well as of the solid carbon, is comparatively perfect. When more air is admitted into the furnace than can be made to enter through the bars, it is generally done by apertures in the furnace doors.

The average rate of combustion throughout the country is far above even the largest quantity named by Mr. Parkes, and may be stated to be about thirteen pounds per superficial foot of grate per hour. With due care in the construction of the furnaces and flues, there seems to be no reason why this quantity may not be as perfectly consumed, and the heat as thoroughly extracted from the products of combustion, before they leave the boiler, as with the smaller quantity. Whether this be so or not, it is necessary in practice to prepare for many cases, as on board of steam-vessels, where it is impossible to allow a larger amount of fire grate, or boiler room, and when it would cease to be ultimately economical to obtain a small saving of fuel, by great additional expense in boilers and their fittings, and in space for them.

To determine the velocity, with which the products of combustion pass off from the furnace, or from the boiler, is attended with much difficulty, on account of the great number of extraneous circumstances which do so easily and so constantly affect it. Some experiments on this subject were made by Dr. Ure, and an account of them was read before the Royal Society, (read June 16, 1836,) when he stated, that he considered the velocity might be taken at about thirty-six feet per second, and as this result has been corroborated by others, it may be assumed, in the absence of better data, as nearly correct.

The subject, in a theoretical point of view, is surrounded by many difficulties—in discovering the allowance which must be made for friction, and other circumstances, similar to those affecting the flow of water through pipes; and though this latter has engaged much more of the attention of scientific men, no very definite results, to bear accurately upon practice, can yet, even in this case, be obtained by calculation.

The practical question of the proper proportions of the different parts of boilers is then proceeded with in the paper, the leading chemical and physical features connected with the combustion of coal in their furnaces having been considered.

The supply of the requisite quantity of air to the fuel on the bars being of the utmost importance, it is usual to make the ash-pit, and the entrance to it, as large and as free as the situation will allow. In marine boilers, or wherever it is necessary to limit the size of the ash-pit, the area for the entrance of the air into it should never be less than one-fourth part of the area of the grate; and in order to facilitate the supply to the back part of the grate, the bars should be made to incline downwards to the extent of about one inch in a foot. No advantageous results will be obtained from increasing the ash-pit, as is sometimes done in land boilers to a very great extent, by making it five or six feet deep; about two and a half feet is sufficiently deep,

even supposing that the ashes are not cleared out oftener than once a day.

The extent of "dead plate" in front of the furnace is not material, as respects combustion; in marine boilers it is generally not more than about six inches broad, which is the width of the water space between the fire and the front of the boiler; but in land boilers it is frequently required to be very broad, to support the brickwork, especially in those cases where the flue is carried across the front.

The amount of the opening between the bars should be about seven-sixteenths of an inch, but this must be regulated by the kind of coal to be burnt upon them; but for any kind of coal, it should not be less than three-eighths of an inch, nor more than half an inch. If the space were made larger, the waste from the amount of cinders, or of small pieces of coke, which would fall through in a state of incandescence, would be considerable; otherwise it would be preferable to have a larger space. In order to facilitate the supply of air, each bar should be as thin as is consistent with the strength required. The bars in general use in this country are one inch or one and one-eighth inch in thickness, but it would be much more advantageous to use them thinner, as in France, where they are frequently used not more than half an inch thick.

The advantage of a considerable amount of space in the furnace, over the fire-bars, has been already mentioned, but no very decisive experiments have been made on this subject. Three cubic feet of space to each superficial foot of grate bar surface, may be stated as a good proportion, where there is nothing to prevent this amount being obtained. When the space is reduced below one foot and a half of grate, it will be found to be attended with a marked disadvantage.

The area of the flue, and subsequently of the chimney, through which the products of combustion must pass off, must be regulated by their bulk and their velocity. The quantity of air chemically required for the combustion of one pound of coal, has been shown to be 150.35 cubic feet, of which 44.64 enter into combination with the gases, and 105.71 with the solid portion of the coal. From the chemical changes which take place in the combination of the hydrogen with oxygen, the bulk of the products is found to be to the bulk of the atmospheric air required to furnish the oxygen, as 10 is to 11. The amount is therefore 49.104. This is without taking into account the augmentation of the bulk, due to increase of the temperature. In the combination which takes place between the carbon and the oxygen, the resultant gases (carbonic acid gas and nitrogen gas) are of exactly the same bulk as the amount of air, that is, 105.71 cubic feet, exclusive, as before, of the augmentation of bulk from the increase of temperature. The total amount of the products of combustion in a cool state would therefore be  $49.104 + 105.71 = 154.814$  cubic feet.

The general temperature of a furnace has not been very satisfactorily ascertained, but it may be stated at about 1000° Fah., and at this temperature the products of combustion would be increased, according to the laws of the expansion of aëriiform bodies, to about

three times their original bulk. The bulk, therefore, of the products of combustion which must pass off, must be  $154.814 \times 3 = 464.442$  cubic feet. At a velocity of 36 feet per second, the area, to allow this quantity to pass off in an hour, is .516 square inch. In a furnace in which 13 lbs. of coal are burnt on a square foot of grate per hour, the area to every foot of grate would be  $.516 \times 13 = 6.709$  square inches; and the proportion to each foot of grate, if the rate of combustion be higher or lower than 13 lbs., may be found in the same way. This area having been obtained, on the supposition that no more air is admitted than the quantity chemically required, and that the combustion is complete and perfect in the furnace, it is evident that this area must be much increased in practice, where we know these conditions are not fulfilled, but that a large surplus quantity of air is always admitted. A limit is thus found for the area over the bridge, or the area of the flue immediately behind the furnace, below which it must not be decreased, or the due quantity could not pass off, and consequently the due quantity of air could not enter, and the combustion would be proportionally imperfect. It will be found advantageous in practice to make the area two square inches instead of .516 square inch. The imperfection of the combustion in any furnace, when it is less than 1.5 square inch, will be rendered very apparent by the quantity of carbon which will rise unconsumed along with the hydrogen gas, and show itself in a dense black smoke on issuing from the chimney. This would give twenty-six square inches of area over the bridge to every square foot of grate, in a furnace in which the rate of combustion is thirteen pounds of coal on each square foot per hour, and so in proportion for any other rate. Taking this area as the proportion for the products of combustion immediately on their leaving the furnace, it may be gradually reduced as it approaches the chimney, on account of the reduction in the temperature, and consequently in the bulk of the gases. Care must, however, be taken that the flues are nowhere so contracted, nor so constructed, as to cause, by awkward bends, or in any other way, any obstruction to the draught, otherwise similar bad consequences will ensue.

An idea is very prevalent that it is advantageous to make the flame, or hot gases, (as they may be termed, because we may look upon flame merely as a stream of gases heated to incandescence,) impinge upon, or strike forcibly, the plates of a boiler at any bend or change of direction in the flue. The turn in the flue is therefore made with a square end, and with square corners; but it is difficult to see on what rational grounds the idea of advantage can be upheld. The gases, if they are already in contact with the plate, cannot be brought closer to it, and any such violent action is not necessary to alter the arrangement of the particles of the gases and bring the hotter particles to the outside, while there is a great risk of an eddy being formed, and of the gases being thrown back and returned upon themselves, when they strike the flat opposing surface; thus impeding the draught, and injuring the performance, of the boiler. That circulation will take place to a very great extent among the particles of

heated gases, flowing in a stream even in a straight flue, will be apparent from those particles next the surface being retarded by the friction against the sides, and by their tendency to sink into a lower position in the stream from their having been cooled down and become more dense. An easy curve is sufficient to cause great change in the arrangement of the particles, as those which are towards the outside of the bend have a much longer course to travel, and are thus retarded in comparison with the others. From these causes the hotter particles in the centre of the flowing mass are, in their turn, brought to the outer surface, and made to give out their heat. The worm of a still is never found returning upon itself with square turns, as if the vapor inside would be more rapidly cooled by its impinging on the opposite surface; yet the best form of worm is a subject which has engaged the attention of many able men, and therefore may well be taken by engineers as a guide in the management of a similar process, though carried on at a much higher temperature.

Another very prevalent practice, and which also would seem to be open to serious objections, is, that the flues are frequently made of much greater area in one part than in another. This arises from a desire to obtain a larger amount of heating surface than is consistent with the proper area of the flue, or with the amount of the heated gases which are passing through it. The flue is thus made shorter in its course than it ought to be in proportion to its sectional area. This is even sometimes done by placing a plate of iron partly across the flue, near the bottom of the chimney, thus suddenly contracting the passage for the gases. The effect of this is evidently to cause a very slow and languid current in the larger part of the flue, and the consequence is, that a deposition of soot rapidly takes place there. In many marine and land boilers, having one internal flue in them, of too large a size, this will be found to be the case, soot being soon deposited, till the flue is so filled up that the area left is only such as is due to the quantity of heated gases passing through it; the value of those parts of the sides of the flue which are covered with soot are thus lost. This is well exemplified in Mr. Dinnen's paper on marine boilers, in the Appendix to Weale's edition of Tredgold, where he states, that the flues of the boiler in H. M. Steamer "African," after she had performed a great deal of work, in the course of five weeks' time, during which period there was no opportunity of sweeping them, were found to be in exactly the same state as after a voyage of five days, or probably as they would have been found after a much shorter time, if they had been examined. These flues are about the same area throughout their whole length, but the chimney is of much less area. In the first portion of the flue from the fire no soot was deposited, but the deposit began after the first turn that the flue took, and gradually increased in amount to the foot of the chimney. The inference that may be drawn from this fact appears to be, that the gases, at first highly heated and thereby expanded, filled the first part of the flue, but as they were cooled they became more contracted in their bulk, regularly towards the chimney, and therefore allowed the soot to be deposited in the space not properly filled by

them in their course, and all soot subsequently formed was carried out at the chimney top by the velocity and power of the current. The amount collected near the foot of the chimney, and in the portions of the flue furthest from the fire, diminished the amount of the surface of the boiler exposed to the action of the heated gases, and the efficiency of the boiler was therefore impaired to the same extent. In those boilers in which the flues, before reaching the chimney, are very much too large, and are contracted, as has been stated, by a plate put across them, the extent to which their efficiency is thus impaired must evidently be much greater and to a serious extent, as this evil exists in them to a very much greater degree.

The due amount of heating surface that ought to be given in a flue to carry off the caloric, or to cool down a given quantity of heated gases, has not yet been investigated with any great degree of accuracy, and practice varies widely under different circumstances. The largest proportion is allowed in the Cornish boilers, some of which have not less than thirty feet and even forty feet of heating surface to one foot of grate. This appears to be more than is justified by any corresponding gain, and certainly more than would be advisable in any marine or locomotive boilers. In boilers burning thirteen pounds of coal per hour on each superficial foot of grate, a proportion of eighteen feet to each foot of grate will be found to give good results. Where slow combustion is carried on, and where an extra size of boiler is not objectionable, some advantage may be gained by increasing the amount in proportion to the amount of fuel consumed. In calculating this surface, it is usual not to include the bottoms of the square flues in marine boilers, and in circular flues from one-fourth to one-third of the surface should be deducted as bottom surface, and therefore not efficient as heating surface. It is not usual to make any distinction between horizontal and vertical surfaces, though it is probable that the former are considerably more valuable. The efficiency, however, of some boilers which have been made with vertical tubes, would rather tend to make it doubtful whether so much difference exists between the value of horizontal and vertical surfaces as has been generally supposed. If the area, instead of being in one large flue, be sub-divided into a number of small flues, or pipes, so as to expose the gases to the required amount of surface in a short course, the distance traversed between the fire-place and the chimney does not seem to be important. The velocity of the current of gases will not be materially influenced by their sub-division, as the whole amount of the surface with which the gases must come in contact, tending to impede their course by friction, will be the same in both cases. It is evident that numerous small flues, by sub-dividing the large stream of gases, which in the other case flow off in one body, bring the greater proportion of the particles at once into contact with the surfaces, and therefore render it unnecessary to pay the same amount of attention to the turning of the stream and the bringing out the hotter particles from the centre of the flowing mass. If these proportions of area through the flues and of heating surface be duly attended to, the results anticipated may be depended upon, whether

flues are of large area or are composed of a large number of small tubes.

The time occupied by the gases in passing through the boiler, from the instant of their generation to that of their leaving the boiler, and the length of the course through which they have traveled, have sometimes been looked upon as matters of great importance. Where the gases are traveling in one compact mass, it is evident that distance and consequently time (as the velocity with which the current flows is the same in all cases) must be allowed, for the different particles of this large mass so to circulate among themselves as that each may have an opportunity of coming into contact with a cooling medium, to give off its heat; but if the large mass of gases is so subdivided that the different particles are sooner brought into contact with the due amount of cooling medium, then the time the gases remain in the boiler ceases to be of importance. When the gases have reached the foot of the chimney, in a well-proportioned boiler, they will be found to be reduced to a temperature of about 500° Fah, or below it; their bulk will, in consequence, be reduced by about one-third below their bulk on their first leaving the furnace. The reduction in the area of the flue ought not to be in the same proportion, because their velocity is no longer so great. The reduction ought to be made gradually, as has been stated before, and not by a sudden contraction at the foot of the chimney, as the effect of this is to cause a slowness of draught in the latter part of the flue, and consequently a deposition of soot; and then the surface so covered, which had been reckoned upon as effective heating surface, is lost. The area of a chimney, to allow the products of the combustion of each pound of coal consumed in an hour to pass off, should not be less than three-fourths of two square inches, this latter being the area given for the flue immediately behind the fire-place—that is, one and a half square inch; and for a boiler burning thirteen pounds of coal per hour, on each superficial foot of its grate, the area should be three-fourths of twenty-six square inches, or nineteen and a half square inches.

Theoretical research not having as yet given us any valuable assistance in determining the proper height of a chimney, we must again refer to practice as our guide. A good draught may be obtained with a very low chimney, but at a great expenditure of fuel, from the necessity that exists in such a case for allowing the gases to pass off at a much higher temperature than would otherwise be necessary. For a chimney built of brick-work the height ought not to be less than twenty yards, and may be increased to thirty yards or forty yards, with advantage to the economy of fuel. When chimneys are carried to a still greater height, it is generally for the purpose of carrying off the smoke, or any deleterious gases, from the immediate neighborhood, or to create a good draught with gases at a lower temperature than those from a steam-boiler furnace. On board steam vessels chimneys are limited in their height by the size of the ship, on account of the influence the chimney has on the stability and appearance. It will generally be found advantageous to make the chimney as high as these circumstances will permit. It will be found

to tend greatly to the efficiency of a boiler to allow a large space in it as a reservoir for steam. The surface for ebullition does not seem to be of much importance in comparison with this point.

In the application of the foregoing proportions to practice, no reference need be had to the form of the boiler; the same results will be obtained whether the boiler be circular, wagon-shaped, or any other form, if all the other circumstances be made the same. By due management in the process of firing, when these proportions are given to the furnace and flues, the combustion will be found to be such that but little carbon will pass off to be converted into smoke, and the results will show great economy in the consumption of fuel.

Civ. Eng. and Arc. Jour.

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*Remarkable Properties of Water and other Fluids, and their connexion with Steam-Boiler Explosions, being a Lecture read before the Members of the Royal Manchester Institution, February 17th, 1845. By JOHN EDDOWES BOWMAN, Esq.*

The lecturer commenced with a few preliminary remarks upon the relation which subsists between the *philosophy* and the *application* of science. It often happens, he observed, that theory follows in the wake of discovery, and that experience grows familiar with important details of practice, before the abstract principle involved, is sought out and clearly recognised. In what he advanced in the present lecture, however, a different sequence will be apparent, and we shall have an illustration of the value of a scientific application of common every day facts, in the solution of problems of the utmost moment to human life. He alluded to the property which liquids possess, of assuming the form of a globe or spheroid, when thrown upon any substance which is at a high temperature. Of this property, a familiar instance is afforded by an experiment performed every day in our laundries. When it is required to know whether a smoothing iron is sufficiently hot for her purpose, the laundress, on taking it from the stove, applies extemporaneously a drop of moisture from her mouth, and if this at once rolls off in the form of a globule, she knows by experience that the iron has reached a proper temperature; while if the drop of water bubbles and boils, however violently, the iron is condemned as not hot enough, and returned to the stove.

Once, then, in the flight of ages past it was discovered that water, though it so readily boils when thrown upon a moderately heated iron, does not boil at all when in contact with metal considerably more heated.

This fact, like many others equally familiar, has been allowed to lie unexplained and uninterrogated, during a long lapse of time; and it is only within the last few years that it has attracted any attention from the physical philosopher.

During his stay in Paris, he had an opportunity of seeing, in the laboratory of Dumas, some experiments performed by M. Boutigny, of Evreux, who has devoted a great deal of time to the subject, and

succeeded in bringing to light some most curious facts; so contrary, indeed, are some of his results to our preconceived ideas, that he confessed he should hardly have believed them possible, if he had not witnessed them. Some of these experiments he described, showing one or two of the most remarkable by way of illustration, and noticing the important consequences of this property of water, in being the frequent cause of steam-boiler explosions.

It is generally stated in books, that a red or white heat is necessary in order to throw the water into this globular form. Far lower temperatures, however, are sufficient. This may be proved by throwing some water into a saucer of melted lead, a metal which melts long before it becomes luminous in the dark: the water shows no appearance of boiling, but rolls about like a little crystal ball for a considerable time.

M. Boutigny, indeed, succeeded in forming a spheroid of water in a capsule floating on oil, heated to not more than  $340^{\circ}$ , which is about  $600^{\circ}$  below what is usually called "red heat."

Liquids more volatile than water become spheroidal at still lower temperatures. Alcohol, for instance, requires to be heated to  $273^{\circ}$ , ether not higher than about  $140^{\circ}$ ; and it is found in general that those liquids which require the highest temperature for boiling, require also the highest to make them assume the spheroidal form.

Water and other liquids, when in the spheroidal state, slowly and gradually disappear, though no appearance of boiling is even observed. This is, of course, owing to slow evaporation, which goes on from every part of its surface, thus enveloping it with a film of vapor.

Of the extreme slowness of the evaporation, some opinion may be formed from the fact, which has been proved by direct experiment, that a quantity of water, which would, under ordinary circumstances, boil away at a temperature of  $212^{\circ}$  in *one minute*, will, if thrown into a vessel heated nearly to redness, require *little less than an hour* for its total dispersion.

[The lecturer here illustrated this property by dropping, from a glass tube, three or four drops of water into a red hot capsule of platinum, which he kept hot, and at the same time boiled about the same quantity in another capsule. The drops of water in the latter evaporated very rapidly, while those in the former became one spheroid, diminishing slowly in size, and rotating for a considerable time after the boiling water had entirely evaporated.]

We have seen, he continued, that when water is thrown upon a surface of red-hot platinum, it does not, as we might have expected, explode violently into steam; but, on the contrary, rolls calmly on its axis like a little world in space, and continues in the liquid state for a considerable space of time. Let us then endeavor to ascertain what is the temperature of the globule of water, and what relation it bears to that of the heated vessel, as well as to that of its own thin coating of vapor.

[Having again formed a spheroid in the same manner as before mentioned, he plunged into it the bulb of a delicate thermometer,

taking care that it did not come in contact with the heated metal. The temperature thus indicated was invariably  $205^{\circ}$ .]

Perhaps one of the most curious facts which have been established in connexion with this subject is, that any variation in the temperature of a vessel containing a spheroid, does not affect the temperature of the spheroid itself. Thus, it is found that a spheroid of water, when contained in a crucible heated considerably below redness, is just *as hot* as one contained in a crucible intensely heated to whiteness in the most powerful blast furnace!

From numerous experiments, indeed, with water, alcohol, ether, and many other liquids, the following law may be deduced:

*That bodies in the spheroidal state remain constant at a temperature below that of boiling, however high the temperature of the containing vessel may be.*

Pure alcohol, which, under ordinary circumstances, boils at a temperature of  $173^{\circ}$ , never rises, when in the spheroidal state, higher than about  $170^{\circ}$ ; and ether, whose usual boiling point is about  $100^{\circ}$ , and which almost boils with the heat of the hand, *cannot be induced, when thrown into a crucible, heated to whiteness in a smith's forge, to rise above  $95^{\circ}$ !* The same remarkable results are obtained, if, instead of pouring the liquids while cold, into the red-hot vessels, they be absolutely *boiling* at the moment; strange and almost incredible as it may appear, the instant they reach their fiery resting place, they absolutely become cooler, and, as it were, shaking off the trammels of all known laws of nature, *cease to boil*. Liquids, then, when in that peculiar physical condition, which I have called *spheroidal*, always remain at one definite temperature; and this temperature is invariably, in the case of every liquid, lower than that at which, under ordinary circumstances, that liquid boils. Let us inquire a little more narrowly into the consequences of this law. Dr. Faraday, by a simple and ingenious contrivance, succeeded, some years ago, in condensing into the liquid state, several of the gases, which had, up to that time, resisted all such attempts, and had consequently been considered permanent gases, such as the air we breathe. This was the case with carbonic acid, chlorine, ammonia, sulphurous acid, and a few others. So great is the elastic force of these liquified gases, or, in other words, so prone are they to boil, and to pass again into the gaseous form, that a very great pressure is necessary to prevent their doing so, and unless the tube or other vessel containing them were very strong, it would probably be burst with a violent explosion. Now, it will readily be understood how it happens that these condensed liquids, unlike water and other fluids, do not require the application of artificial heat to make them boil, but, on the contrary, continue to boil, even when cooled far below the usual temperature of the air. Let us then inquire whether any of these liquids, whose boiling points are far below that at which water freezes, be subject to the same laws to which water is subject when they are thrown into a vessel sufficiently hot to cause them to pass into the spheroidal state.

The gas which is the most easily liquified of those alluded to, is

sulphurous acid, which requires at a temperature of  $45^{\circ}$  a pressure equal to two atmospheres (or about 30 lbs. to the square inch of surface) to prevent its boiling. If this pressure be removed, violent ebullition takes place; and it has been found that, even when cooled as low as  $14^{\circ}$  of Fahrenheit's thermometer, or, in other words,  $18^{\circ}$  below the melting point of ice, it boils in precisely the same way as water boils when heated to  $212^{\circ}$ . Fourteen degrees, then, is the *boiling point* of sulphurous acid.

But we have found that when liquids, even while boiling, are thrown into a heated crucible they *become cooler*, and remain constantly at a temperature a few degrees below their boiling point. What, then, will be the effect of pouring into a red-hot crucible a few drops of liquid sulphurous acid? The experiment which was selected for the purpose of furnishing an answer to this question is, perhaps, one of the most striking and apparently paradoxical in the whole range of physical science. Liquid sulphurous acid is subject to the same remarkable law as water and other liquids, in being invariably, when in the spheroidal state, at a temperature lower than its boiling point, which is  $14^{\circ}$  of Fahrenheit, so that if a spheroid of sulphurous acid be formed, it remains constant at a temperature of about  $12^{\circ}$ , even though the crucible containing it be at a red or white heat. If a little water, contained in a small bulb, one-eighth or one-tenth of an inch in diameter, be immersed in the spheroid of acid, it is almost instantly frozen, thus affording incontestible evidence of the remarkably low temperature of the spheroid. Most persons have seen the well-known lecture-table experiment of causing water and other liquids to boil in vacuo at temperatures considerably below their ordinary boiling points, a result depending upon the diminished pressure on their surface.

When liquids in the spheroidal state, however, are placed under the receiver of the air-pump, and the air removed, no sign of boiling is even perceived. We may therefore suppose that the temperature of the spheroid in vacuo, is lower than when exposed to the atmospheric pressure, as otherwise ebullition would inevitably take place. The lecturer was not aware, however, that the temperature had ever been examined with a thermometer under these circumstances, and thought it would be by no means easily done.

He should, probably, scarcely be believed, when he stated that even liquid sulphurous acid does not, when contained in a red-hot crucible, and in the spheroidal state, boil in vacuo.

If a thermometer is held in the atmosphere of vapor which surrounds a spheroid of water, it will give a far different result from that ensuing from its immersion in the globe itself.

Instead of indicating, as before,  $205^{\circ}$ , however hot the crucible may be, the degree at which it stands will now be found to depend entirely on the temperature of the latter. If it be heated to  $400^{\circ}$ , the thermometer will rise to that point; or if the crucible be raised to a red heat, a mercurial thermometer, graduated to  $600^{\circ}$ , is burst instantly, showing a temperature considerably higher. We have shown, experimentally, that when water is thrown into a red-hot crucible, it

does not, as common sense would have foretold, begin to boil, but remains constant at the temperature of  $205^{\circ}$ , so long as it retains the spheroidal form, however high the temperature of the crucible may be, but that the vapor surrounding it is, on the contrary, always about the same temperature as the crucible.

This comparatively low temperature of liquids in the spheroidal state, is generally attributed to the coating of vapor round the spheroid being incapable, as it is conceived, like all other gaseous bodies, of *conducting heat*. This explanation, however, though ingenious, does not meet all the difficulties of the case: for, besides the heat which would be conducted by the coating of vapor, if the vapor had the power of conducting it, (which is possible,) there is the enormous quantity of *radiant heat*, emanating from all parts of the heated crucible. If a vessel containing water be placed near a fire, it is well known that it gradually becomes warm, and if the fire be a good one, and the distance not too great, the water will shortly boil. The heat which causes the water to boil in this case, is not conducted by the fire to the water through the intervention of the air, since we know that air has no such power; but it is a portion of that which, like light from a candle, radiates from the fire in all directions, and is absorbed more or less completely by any substance which stands in its way, and intercepts its passage. Why, then, does not the spheroid of water, surrounded as it almost always is, by intensely heated metal, absorb the rays of heat, which dart towards it from every side, become intensely heated to the boiling point, and dispersed in vapor with explosive violence? In order to answer this question, some philosophers have stated that the radiant heat, when it meets with any liquid in the spheroidal state, passes through it without experiencing any interruption, and consequently does not impart any heat to it. A simple experiment is sufficient to show the fallacy of this hypothesis.

If a crucible be made red hot, and a small bulb of glass, containing water, be brought near to its inner surface, the water boils violently, owing to the absorption of radiant heat, and notwithstanding the presence of a quantity of non-conducting air between the heated metal and the water. This shows that heat *does* radiate from the sides of the crucible, and, too, in sufficient quantity to cause water to boil with considerable violence. If now the crucible be again heated to an equal degree, and a few drops of water poured in, they at once assume the spheroidal state. Things being in this condition, let the little glass bulb containing water be immersed in the spheroid, and it is found that the water does not show the slightest tendency to boil. The spheroid of water has consequently, in some way or other, prevented the rays of heat from reaching the glass bulb, and the water which it contained.

But if, according to this hypothesis, the radiant heat passed through the substance of the spheroid, without being to any extent absorbed or arrested by it, it would obviously reach the bulb containing the water, and cause it to boil with as much violence almost as it does when no spheroid is interposed between it and the source of heat.

Another mode of explaining the low temperature of liquids in the spheroidal state, is clearly pointed out by the result of this experiment, which proves, beyond all doubt, *that bodies in the spheroidal state have, when they have attained their maximum temperature, (which we have found to be always lower than their boiling point,) the remarkable property of reflecting, almost completely, radiant heat.*

A curious variation of the last experiment, tending to the same conclusion, may be made by putting a piece of ice into the red-hot crucible. It instantly absorbs sufficient heat to cause a portion of it to become spheroidal, after which it continues at a temperature of  $205^{\circ}$ , even though a portion of the ice remain unmelted within the globule. Thus the ice, and afterwards the water, which has an almost perfect *reflecting power* at  $205^{\circ}$ , absorbs, instantaneously, as it were, all the heat necessary to raise it to that temperature, and above which it does not become heated! *Why and how* is this? are questions which, in the present state of our knowledge, cannot be answered; and we have here one of those deep mysteries, so frequently met with in our researches into the hidden laws of nature, which baffle and confound the reason, and set at nought, for a time, at least, the power of the human mind.

We have seen that not only water, but also alcohol, ether, and liquid sulphurous acid, may be obtained in the peculiar condition, which he had, on account of the external form which always attends it, called the *spheroidal state*. It becomes interesting to inquire, whether so remarkable a change may be produced in other liquids. A great number of experiments have been made with almost every kind of liquid; solutions of acids, alkalies, and salts; compressed gases and melted solids; fats and oils of every kind, both volatile and fixed; and they tend to show that all liquids, with scarcely an exception, pass, under favorable circumstances, into the spheroidal state. The temperature necessary to produce this effect, appears to bear some relation to the boiling point; those which boil most readily requiring a lower temperature than the less volatile substances. That a drop of water, or other fluid, when in the spheroidal state, is poised, as it were, without support, at some sensible distance from the surface of the vessel containing it, may be proved in many ways. If a spheroid of some opaque substance be formed on a nearly flat surface, and then interposed between a lighted candle and the eye, the image of the flame is distinctly seen between the hot surface and the globule. This effect might be produced if the spheroid were in a state of rapid motion up and down, since the image of the candle, seen during the ascent, will remain visible till the next ascent; just as an ignited point in rapid revolution appears as a circle of light. That this is not the case, however, may be shown in another way. If silver be touched with nitric acid, it is rapidly corroded, and in a short time dissolved; but if a quantity of nitric acid be poured into a crucible or dish of silver, sufficiently hot to induce the spheroidal state, no corrosion whatever will take place—clearly proving that the acid is at no time in absolute *contact* with the metal. That this is not owing to any

deficiency in the strength of the acid, may be seen by placing in the spheroid a piece of *cold* silver, when violent action, of course, takes place, nitrous fumes being given off, and nitrate of silver formed. A remarkable effect may be produced, owing to this repulsion between liquids and heated solids, if a large spheroid of water be formed on a surface nearly flat, and a small bar of white or red hot iron be then thrust into the middle of it. *Contact* being impossible between the bar and the water, the latter forms a ring at some little distance from the heated bar, presenting very much the appearance of Saturn and his ring. Whether any real analogy exists between the two effects, or whether the causes be in any way connected, further researches into the nature of that anomalous appendage of the planet may perhaps decide.

We have now passed in review the most important phenomena presented by water and other liquids, when thrown into vessels raised to a high temperature. We found, in the first place, that water may be made to assume the globular form, when placed in a cup heated only to  $340^{\circ}$ , which is less than  $130^{\circ}$  higher than its boiling point; and that the temperature necessary to convert other liquids into spheroids bears some proportion to their several boiling points—that for alcohol being  $273^{\circ}$ , and that for ether,  $140^{\circ}$ . Secondly, we found that the rapidity with which water in the spheroidal state evaporates, is in proportion to the temperature of the heated vessel containing it, but that the evaporation of water in a spheroidal state is, at a temperature of  $400^{\circ}$ , fifty times more slow than that of ordinary boiling water at  $212^{\circ}$ . On examining into the temperature of liquids in the spheroidal state, we arrived at the remarkable result, that *whatever the temperature of the containing vessel may be, that of the spheroids is invariable, and always below their boiling points*. Thus, a spheroid of alcohol always stands at  $170^{\circ}$ , or  $3^{\circ}$  below its boiling point; one of ether is always  $5^{\circ}$  below, or  $95^{\circ}$ ; and liquid sulphurous acid, which boils at  $14^{\circ}$ , never reaches even that low temperature when in the spheroidal state, but continues far colder than melting ice, even though the crucible in which it lies *be all the time at the most intense white heat*. Fifthly, we found that the only way of explaining this low temperature of spheroids, is to suppose that they have the property of reflecting, in a very perfect manner, the radiant heat emanating from the sides of the hot crucible, and are in this way protected from the scorching rays which would otherwise cause them to burst violently into steam. In the sixth place, it appeared that, with scarcely any exceptions, *all* liquids may be made to pass into the spheroidal state. And, lastly, there appeared strong evidence to prove that spheroids are never in absolute contact with the vessel containing them.

Prac. Mec. and Eng. Mag.

To be Continued..

*Extract from a memoir upon the action of the Perchloride of Gold upon the Hyposulphite of Soda.\**

It is known that, by mixing determinate quantities of perchloride of gold and hyposulphite of soda, previously dissolved in water, a liquid is prepared which is now used to fix daguerreotype pictures. The chemical nature of this liquid is completely unknown: we thought that a thorough examination of its composition and properties would furnish the means of remedying some of the inconveniences which it presents. The result has shewn that we were correct.

To obtain this liquid, the preparation and use of which are due to M. Fizeau, we dissolve one part, by weight, of chloride of gold in five hundred parts of pure water, and three parts of crystalized hyposulphite of soda in the same quantity of water. The solution of gold is then poured little by little into that of the soda, stirring the whole time: the liquid at first reddens, but soon becomes colorless. It is too dilute to be analyzed, and as it is impossible to concentrate it, we were compelled to have recourse to the mutual reaction of chloride of gold and hyposulphite of soda, dissolved in very small quantities of water. A liquid obtained under these circumstances, is very abundantly precipitated by alcohol, at 40°.

The reaction is the same as when we take the re-agents more dilute, only the mixture must be made with more precaution; especially, after each addition, we must wait until the discoloration is complete, otherwise we cannot avoid the formation of a brown substance, which is difficult to be got rid of, and which is the result of the reaction of the perchloride of gold upon the products first formed.

The precipitate obtained by alcohol from this solution is a mixture of several different salts; it is almost altogether composed of a salt which we are about to describe, but it contains, besides, variable quantities of all the products contained in the supernatant liquid.

To purify it, it is necessary to redissolve it several times in succession, in a small quantity of water, and to precipitate it each time by absolute alcohol.

The salt thus purified is perfectly colorless, crystalizes in needles, insoluble in strong alcohol, and but slightly in ordinary alcohol; but, on the contrary, excessively soluble in water. Its taste is sweet.

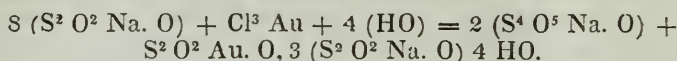
Its aqueous solution possesses all the properties of M. Fizeau's liquid; and, in fact, M. Lerebours, who has carefully compared the action of these two liquids, even gives a preference to the solution of our salt, in consequence of the richness of the tones which it gives to the picture.

It is the active material of M. Fizeau's liquid, freed from all foreign matters. Careful analyses shew its composition to be  $S^2 O^2 AuO^2 + 3 (S^2 O^2 Na. O) + 4HO$ .

\* In a memoir by Messrs. Fordos & Gelis, published in a late number of the "Annales de Chimie," they describe a new salt, to which we desire to call attention, as likely to be of use to those engaged in daguerreotyping.

It is, therefore, a double hyposulphite of gold and soda, with four equivalents of water.

The investigation of this salt, and of the supernatant liquid, shews that the action of the perchloride of gold upon the hyposulphite of soda, may be represented by the following equation :



There is therefore formed a bisulphuretted hyposulphate of soda, which plays no useful part in fixing the daguerreotype pictures; we may even say that, by the ease with which it abandons its sulphur under the influence of heat, it may contribute to the formation of those black spots which so often compel us to abandon the most perfect impressions. It is also probably owing to its presence that the change which M. Fizeau's liquid undergoes, when kept, is to be attributed. All those who have frequent occasions to use it, know that it can scarcely ever be kept for a month. This inconvenience renders it necessary for each amateur to prepare it for himself, which is difficult. For although the preparation is simple and easy for those who are accustomed to chemical experiments, it is by no means so for amateurs: to succeed, they must conform exactly to M. Fizeau's instructions, and especially employ perfectly pure materials, which it is not always easy to find in commerce.

We believe, therefore, that it will be found useful to substitute the salt which we have just described, in place of the liquid of M. Fizeau; it will then suffice, in order to obtain a suitable liquid, to dissolve one and a half parts, by weight, of the salt in one thousand of water. Such was the liquid used by M. Lerebours. In conclusion, this substitution will permit us hereafter to transport, in a very small bulk, quantities of this salt, which represent enormous masses of the liquid, and this last advantage will be particularly felt by traveling photographers.

Ann. de Chim. et de Phys., April, 1845.

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*Experimental Researches into the Properties of the Iron Ores of Samakoff, in Turkey, and of the Hæmatite Ores of Cumberland, with a view to determine the best means for reducing them into the cast and malleable states; and on the relative strength and other properties of cast-iron from the Turkish and other Hæmatite Ores.* By WILLIAM FAIRBAIRN, M. Inst. C. E.

In the smelting and manufacturing of the poorer iron ores, as they are commonly called, being those in which a large proportion of alumina, silica, and other foreign matters are contained, many important improvements have in modern days been effected; but in the reduction of the richer sorts—hæmatite ores, those more nearly approaching pure iron, with very little admixture of other substances, there has been scarcely any change, from the old and expensive methods, which have for several centuries prevailed in this and other countries. It is remarkable that the proprietors of the richer minerals

should have allowed the makers of iron, from ores of leaner quality, such as the blackband and kidney ores, to have so far outstripped them.

Except the successful experiments of Mr. Heath, at the Works of Porto Nuovo, in the East Indies, and the attempts now making by the Cleator Company, near Whitehaven, there are few instances of improvements in the smeltings of rich ores, either in this country or on the continent. It has been stated, that the Swedish iron manufacturers have introduced some alterations into their works, but they appear to be of minor importance, and to be scarcely entitled to the name of improvements upon the old process used in that country for a long series of years.

It is to Mr. Ohanes Dadian, an active and enterprising Armenian, in the service of the Sublime Porte, that we are indebted for the present inquiry; and by that gentleman's determination to surmount every obstacle, and to solve the doubts of some eminent chemists, the present results were obtained. Amongst other duties devolving upon Mr. Dadian, in his recent visit to this country, was that of placing in the hands of competent persons, some samples of ores which were sent from Turkey, for the purpose of experiment. The first samples were small in quantity, but a more recent supply, accompanied with some specimens of bituminous coal, enabled the experimenters to enter upon the subject with increased confidence, and to pursue the inquiry with much greater prospects of success. In addition to this, Mr. Dadian had full power to engage persons duly qualified for the investigation, and whose skill and practical knowledge would entitle them to the support and confidence of their employers.

In consequence, Mr. W. N. Clay was engaged as chemist and metallurgist, and Mr. John Hague as engineer.

As the greater part of the experiments were conducted under the superintendence of these gentlemen, their separate reports are given in the order in which they were made; and to prevent confusion the facts are recorded as they occurred, from time to time, in the experiments.

Previous to Mr. Dadian's visit to England, he had collected information relative to the fuel, limestone, &c., in the district of country where the ore is found; and from the abundance and quality of the materials, it is presumed that a moderately cheap iron of very superior quality may be obtained.

From the description of the country, as given by Mr. Dadian and by Mr. Zohrab, who visited the locality some years since, it appears, that the ore is brought down the rivers from the higher districts, and is deposited in the lower valleys, at a short distance from the sea; extensive tracts of country are thus covered to a depth sufficient to insure an almost inexhaustible supply.

Before any definite plan could be adopted for the reduction of the ores, it was deemed necessary to ascertain, by careful analysis, their composition and value, and for these objects Mr. Dadian, when last in Paris, consulted Monsieur Dumas, the chemist, and from that gentleman he received a favorable report: that report is not in the author's

possession, but from statements received, it appeared only to have differed in a slight degree from that of Mr. H. H. Watson, of Bolton, whose analysis of the samples (which may be taken as a fair average of the whole) gave—

One atom 28 + one atom S = protoxide of iron.

Two atoms 56 + three atoms 24 = peroxide of iron.

$$\begin{array}{r} \hline 84 \qquad \qquad \qquad 32 \\ \hline \end{array}$$

84 metal + 32 oxygen = 116 black oxide.

Then 116 : 84 :: 88 : 63.72 + quantity of metal per cent. in the ore in question by theory.

In this statement Mr. Watson observes, “that the oxide readily dissolves, when the ore is heated in powder with hydrochloride acid;” and by thus treating 100 grains of the ore, he obtained a solution of the oxide, and had 12 grains of siliceous earth undissolved; the proportions would therefore be—

Protoxide of iron	}	88
Peroxide of iron		
Siliceous earth		12
		<hr/>
		100

From the above it is evident that the ores are nearly pure oxides of iron; they are rich in quality, highly magnetic, and may be easily separated from extraneous matter by the magnet. In some of the processes this separation may or may not be necessary, but in case the silica be found injurious, the process of cleansing may be effected by a series of magnets fixed on the circumference of a wheel, which, in moving through the loose ore, would attract the iron and carry it round to a revolving brush, acting upon the periphery, and thus deposit the metal into a receiving box on the opposite side. This is probably the best method for obtaining the perfectly pure oxides; but the most expeditious mode would be to cleanse it with a fan, in the same way as farmers winnow grain, by blowing the lighter particles to a distance, and allowing the metallic granules, as being of higher specific gravity, to fall short into a separate receiver. A third method would be, to wash the ore in a current of running water, and thus free it from all superfluous matter not required in the process of manufacture. But in these different cleansing operations, an excess of the siliceous earths is assumed, and moreover that these mixtures are detrimental to the process of deoxidation, to be effected either before or after the change in the furnace.

Now, it is not altogether clear that such is the case, and in the absence of experiment it is reasonable to suppose, that instead of these earths proving injurious they might be found useful, in combining with the limestone as a flux, and thus vitrifying the silex at the same instant the deoxidating process is going on.

These opinions are entitled to some weight, as the separate reports of Mr. Clay and Mr. Hague (although their views are not altogether

similar) still inculcate the necessity of adopting some effective process of deoxidation.

Before advertng to the experiments, it will be necessary briefly to state the opinions of several manufacturers, to whom the ores were submitted for inspection, and to whose sound practical views the country is indebted for many valuable improvements in the chemical as well as the mechanical process of the art.

To the iron-maker and engineer, a minute chemical analysis is of less importance than a knowledge of the methods used in the treatment of similar ores, derived from experimental and practical research. It is true, that none of the iron ores of this country will bear a comparison, in point of richness, with those of Turkey, excepting, probably, the red ores of Lancashire and Cumberland, which, although varying in their chemical compounds, are in other respects comparative, and exhibit (with the exception of the magnetic properties) characteristics of a very similar description.

According to Dr. Colquhon, of Glasgow, the Ulverstone ore contains—

	Gr.
Peroxide of iron,	90.3
Silica,	5.0
Alumina,	3.0
Lime, }	traces.
Magnesia, }	
Water,	6.0
	<hr/>
	104.3

This, by calculation, would give an average of 62 per cent. of iron, of nearly the same degree of richness as the ores of Samakoff, which, from Mr. Watson's analysis, yields 63.72.

Dr. Colquhon, in his inquiry into Mr. Clay's new process for making malleable iron direct from the ore, states, "that the red ores of Lancashire and Cumberland (which are a species of hæmatite) are exceedingly pure," and from an average sample, made up with great care, he found its constituents composed "of 63 per cent. of iron, 8 per cent. of earthy matter, and minute quantities only of lime and magnesia." In other respects the ores were entirely free from phosphorus, arsenic, and sulphur.

From this statement it is obvious that the Ulverstone ores, operated upon by Dr. Colquhon, do not widely differ from those analyzed by Mr. Watson; and viewing their other properties, they may be considered to approximate, irrespective of the quantity of metal produced in each.

Concerning the other iron ores of this country, unfortunately none of them are analogous to those of Turkey, either as regards their chemical constituents, or the process by which they are reduced. It is the opinion of all the practical iron masters who have been consulted, that in smelting, the latter would require a different treatment

from that pursued with the ores of this country; but in making malleable iron, they are all agreed as to its fitness for Mr. Clay's new process, and that large quantities of the finest quality might be made direct from the ore, at a moderate rate of charge.

On these points there is but one opinion, but the manufacturers are somewhat startled at the idea of a new process of preparation; the smelting being considered a work of difficulty, from the expense and trouble which must be incurred, before the preparatory process of roasting can be accomplished. In fact, these opinions would infer that the whole must be looked upon, for some time to come, as an experiment, and that more particularly as the material to be worked upon is entirely new, and may present features of an exceedingly obdurate and refractory character. To a certain extent these views may be correct, as an excess of silix might prove exceedingly troublesome, and even with every care in the process of smelting, instead of a carburet, (by which the melting pigs of this country are so well known, and so justly appreciated,) a silicate of iron might be the result. It is true, that a flux of lime and a certain proportion of aluminous clay might remove, or in a great degree neutralize, the effects; but that can only be determined by experiment, and with such obstacles in advance, it will be necessary to guard against them, and to arrange future operations with a view to their removal.

But supposing them to be overcome either by this, or by the cleansing process already alluded to, or by such other means as may be deemed expedient, it is then to be considered how the minute particles of the ore are to be retained in the furnace, during the application of a strong and intense blast. It is clear that some process of calcination must be adopted, in order, not only to deprive the ore of part of its oxygen in the first instance, but to effect its carburization, and to hold it together until it is fused. For these objects the following experiments were entered upon, under the directions of Mr. Clay and Mr. Hague.

The first operation was to convert one of the cupola furnaces (4 feet diameter) at the Canal Street Works, Manchester, into a blast furnace; this was effected by lining it with fire-bricks to a height of 15 feet, leaving a hearth of 18 inches square, and 18 inches deep; it was made 2 feet 6 inches diameter at the boshes, and tapered to 18 inches at the top; with this furnace, and a moderately good fan blast, the experiments were made.

Previous to making the experiments at Manchester, Mr. Hague had tried the ores in various ways, and had subjected them to analysis and experiment. The first was made with only

4 oz. of iron ore,  
4 oz. of chalk,  
3 oz. of bottle glass,  
 $\frac{3}{4}$  oz. of charcoal,  
 $\frac{1}{2}$  oz. of clay.

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12 $\frac{1}{4}$  oz.

which, having been deoxidized in a close vessel, and melted in the

crucible, produced a super-carburet of good No. 1 pig iron, and which worked freely under the chisel and file.

The next experiment was on a larger scale, and consisted of

30 lbs. of iron ore,  
10 lbs. of bottle glass,  
8 lbs. of clay.

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48 lbs.

This, after being roasted, was pulverized, and mixed with water; it was then formed into bricks, and subsequently melted, with a limestone flux, in the cupola, by a fan blast, and produced a hard white iron, of a quality varying between No. 3 and No. 4 pigs.

The last experiment was repeated, with the addition of 2 lbs. of clay and 2 lbs. of common salt; 10 lbs. of scoria from the last melting being substituted for the bottle glass. The produce of this mixture was a white No. 3 iron, nearly the same as the last.

Other tests of a similar kind were made, with nearly the same success, but no change of any moment occurred in the quality of the iron, until experiments on a more extended scale were adopted. These are given in the words of the experimenter.

To be Continued.

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*An Account of the cause of the Colors in Precious Opal.* By SIR  
DAVID BREWSTER.

This gem is intersected in all directions with colorific planes, exhibiting the most brilliant colors of all kinds. The cause of these colors has never, we believe, been carefully studied. Mineralogists, indeed, have said that they are the colors of thin plates of air occupying fissures or cracks in the stone; but this is a mere assumption, disproved by the fact that no such fissures have ever been found during the processes of cutting out, grinding, and polishing, which the opal undergoes in the hands of the lapidary. In submitting to a powerful microscope specimens of precious opal, and comparing the phenomena with those of hydrophanous opal, Sir David Brewster found that the colorific planes or patches consist of minute pores or vacuities arranged in parallel lines, and that various such planes are placed close to each other, so as to occupy a space with three dimensions. These pores sometimes exhibit a crystalline arrangement, like the lines in sapphire, calcareous spar, and other bodies, and have doubtless been produced during the conversion of the quartz into opal by heat under the peculiar circumstances of its formation. In some specimens of common opal the striature is such as would be produced by a kneading of crystallized quartz when in a state of paste. The different colors produced by these pores arise from their different magnitude or thickness, and the colors are generally arranged in parallel bands, and vary with the varying obliquities at which they are seen.

Athenæum.

*Experiments with Iron Targets at the Arsenal, Woolwich.*

The following experiments were undertaken lately, to determine the effect of shot upon the hull of an iron vessel, and also with the view of providing means for stopping the passage of water through a shot-hole near the water line. This latter object is sought to be effected by packings of various kinds fixed behind the sheathing-plates, which by their elasticity will close over the hole after the passage of the shot through them.

The gun used in these experiments is a 32 pounder, placed at the distance of 30 yards from the target, and was loaded with the full charge of 10 lbs. of powder, and also with 2 lbs. and 1 lb. to produce the effect of a spent shot.

The initial velocity of the ball with the full charge is about 1800 feet per second, and with a 2 lbs. charge, 1000 ft. The diameter of the shot is 6 inches.

*Target No. 1* is made of three thicknesses of  $\frac{1}{2}$  inch plates rivetted together by double rows of rivets arranged in rectangles of 24 inches  $\times$  14 inches. A shot fired through this with the full charge made a clean hole of its own diameter, with very little tearing or raising of the edges, and no rivet head started near the hole. The round piece cut out by the shot is broken into angular splinters of one, two, or three inches long, which diverge from the hole in all directions and with great violence. When the full charge is used no disturbance in the plate or the rivets round the hole is observable.

This target was not stiffened with angle-irons.

No lining is placed behind this target.

*Target No. 2* is formed of single  $\frac{1}{2}$  inch plates, flush jointed, single-rivetted, with frames 9 inches deep attached by double angle iron 6  $\times$  3 inches. The frames are 33 inches apart.

One half of this target is lined at the back with pure India-rubber, and the other half with a mixture of India-rubber and cork-dust, containing 25 per cent. of the latter by weight; it is 12 inches thick. These linings are held to the sheathing by 1 inch screw-bolts with square heads outside, and nuts with washers of  $\frac{5}{16}$  inch plate, 8 inches square inside, the washers completely covering the elastic lining. The bolts are in the centre of each square, or 8 inches apart.

Through the India-rubber and cork-dust, five shots were fired, all striking as was intended between the heads of the bolts. Two shots with the 10 lb. charge made clean perforations through the outer plate and passed through the lining without shattering it much, but each shot knocking off four or five of the back plates with great violence. The splinters from the outside plate all passed through the lining and radiated as before mentioned. After the passage of the shot, the elastic lining closed completely over the hole, so as to become impervious to light and apparently to water.

Several proportions of India-rubber to cork-dust have been tried, but the proportion before mentioned is considered the best. Three other shots were fired through this lining with the 2 lb. charge of powder, and were purposely made to strike within a circle of 12

inches diameter, so that the three holes joined; still the lining closed over the holes so as to exclude light, or prevent the passage of a thin walking-stick through it in any direction, which was considered very satisfactory. Of course, a great many of the back plates, about eight, were torn off.

With the small charge of powder the sheathing-plate suffers much more than with the full charge, the plate being considerably drawn into the hole, raising the edge inside, and stripping off the rivet heads near it. A shot fired with one pound of powder produced this effect in a greater degree, but in all cases the ball seems to carry with it a part of the outside plate torn from the hole, the piece increasing in size with the velocity of the cannon ball.

During an experiment with this target on the 3d June, a splinter struck a sentinel on duty at about 200 yards distance, passing entirely through the calf of his leg. It was a flat piece about the size of a penny, and must have glanced from the target at a very obtuse angle, and returned by the resistance of the atmosphere to where the man was standing, which was some way in advance of the horizontal line of the target.

A weak shot was passed through the lining of solid India-rubber, (12 inches thick,) which completely closed over the hole, apparently excluding the passage of water, and even air. This shot caused a great dislocation of the plates at the back, a number of which were driven off by the breaking of the nuts, consequent on the pressure thrown upon them by the tenacity of the India-rubber. The targets are 6 feet square.

*Target No. 3* is formed of double  $\frac{1}{2}$  inch plates rivetted together, and no frames. Half of this target is lined with solid India-rubber 8 inches thick, and held on by screw bolts and square washers as before. One chief objection to India-rubber as a lining for ships is its great expense. It would be also difficult to *confine* it in warm climates, as it assumes a kind of semi fluid motion when acted on by its own gravitation. The other half of this target is lined with a mixture of India-rubber and cork-dust, 12 inches thick, held on as before. In this case the cork-dust (which is cork chopped very fine) was in too large a proportion for the India-rubber, and consequently the hole formed by the shot did not close, and the lining itself was very much shattered.

*Target No. 5* is formed of two plates, having a space of 10 inches between them, half of this space being filled in with felt, and half with India-rubber and cork-dust introduced in small pieces through hand-holes cut in the ceiling-plate between the frames, (which are 15 inches apart.) The outer sheathing-plate is  $\frac{3}{8}$  inch thick, and the inner  $\frac{5}{16}$  inch. The felt proved of no use in stopping the hole, and by its pressure it tore away a large portion of the ceiling-plate, about two square feet, where the ball passed through. This large piece was quite detached from the plate in various fragments which seem to have broken off quite short. A similar effect was produced in the ceiling-plate by the passage of the ball through the lining of India-rubber and cork-dust, and the latter from being introduced in small

pieces by the hand-holes did not close over the hole, and was very much shattered.

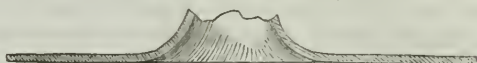
Effect of a 10 lb. charge.



Effect of a 2 lb. charge.



Effect of a 1 lb. charge.



It is found that a ball, whatever be its velocity, produces much the same effect upon the elastic lining, although not so with the iron plate, as we have shown. This will be better illustrated by the annexed sketches of the effect produced on the plate by different charges of gunpowder.

Glas. Mec. Jour.

### *Mode of Neutralizing the Local Attraction of Iron Ships on the Compass.*

Mr. C. D. Hays, who conducted two experimental voyages between London and Cork, with the view of testing his patent method of applying the joint powers of the steam-engine and the screw as auxiliaries to sailing vessels, has made, at the same time, some observations on the effects of iron vessels on the compass, which promise to be of great service. In a pamphlet on the subject he states:—"With a view of obtaining more correctly the error of the compasses, a person was taken on board to go as far as Gravesend, to endeavor to regulate them by the different bearings; but from the great variety found in every alteration of position of the ship's head, he could come to no satisfactory conclusion; he was then kept on board to proceed further down channel. Shortly after leaving Gravesend, Mr. Hays placed a triangle immediately over the rudder-head, on which he placed an azimuth compass, which, when compared with the direction of the river, appeared to indicate the position of the ship's head correctly, and from observations subsequently made, was found to act with the most perfect exactitude.

"Observations were continued from different bearings of the lights and headlands compared with the courses and distances made during the whole of the voyage to and from Cork, as well as from corrections while in port, from the whole of which, the compass over the rudder-head was found *exactly correct*, while that in the binnacle varied from one to three points. Compasses were also placed in different parts of the vessel, but in every other position than *immediately* over the stern-post and rudder-head, a variation was shown. The common compass, as well as the azimuth, was placed over the rudder-head, and showed the same results.

"The height of the triangle on which the compass was placed from the head of the rudder was three feet six inches, the axis of the needle exactly plumbing the top of the iron post of the rudder; raising and lowering it produced no alteration.

“The idea of placing the compass in that position suggested itself to Mr. Hays from a conversation he had with Captain Hoskin, of the *Great Britain* screw iron steam-ship, on the subject of the trouble and difficulties attending the direct regulation of the compass on board iron vessels, in which Captain Hoskin mentioned that, when they were correcting the compasses on board that ship at Bristol, it appeared to him the error diminished the nearer the compass was placed over the rudder-head and stern-post.

“Inferring from the above fact, that the neutralization was effected by the perpendicular attraction of the upright bars of the iron forming the mainpiece of the rudder on the needle, Mr. Hays placed a bar of iron immediately under the compass in the binnacle, as well as under compasses placed in other parts of the vessel, but without producing any sensible effect; that, however, he does not think sufficient to upset the theory of the perpendicular attraction, as the bars so placed were not a fourth-part of the length of the stern-post or mainpiece of rudder; and in giving the results of the above observations he merely wishes to publish a fact which may prove valuable in adjusting the compasses on board iron vessels. The method now employed consists in counteracting the local attraction of the vessel by the more powerful attraction of magnets placed about the compass, which not only are subject to variation of power by lapse of time and other causes, but may be displaced, destroyed, or lost, from numberless accidents to which vessels are subject at sea.”

Athenæum.

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*Metals and Metallic Properties.*

On Saturday last, Professor Faraday continued his series of lectures on metals and metallic properties, by discussing the peculiar characteristics of iron, and, in connexion with it, those of steel. The extreme malleability of the former was clearly demonstrated, and illustrated by various beautiful experiments; its tenacity and ductibility being also ably dilated on, as well as its affinity for the other metals. Some fine specimens of the ore were displayed, and the inherent properties of the metal in that undeveloped state ably considered. The lecturer described the process of rendering the metal at once tough and strong, being thus adapted for purposes requiring such valuable features; and stated that this property of toughness was easily removed by a violent concussion, and mentioned the fact of Mr. Nasmyth's opinion being, that the axles of railway carriages so frequently snapped asunder, though previously rendered of extreme toughness and strength, from the constant percussion occasioned by the wear and tear of 3000, or upwards, of miles of traveling. The original qualities were, however, easily reinstated by a repetition of the same process that first gave it the necessary adjuncts. The properties of steel, and its formation from the parent mineral, iron, were practically illustrated. The iron being submitted to a high heat, the carbon crept into the metal, as in the manufacture of iron it crept out, and the result was, the formation of a new and exceedingly valuable metal, possessing all the toughness and malleability of iron,

and the fusibility of cast-iron, while, at the same time, its increased hardness rendered it capable of receiving the finest edge and the highest polish. Some very beautiful specimens of swords, both of home and foreign manufacture, were exhibited by the lecturer: that presented by the Emperor of Russia to Sir Edward Codrington, for his victory at Navarino, being of Siberian manufacture, and bearing on it representations of that battle, and inclosed in a beautiful sheath, overlaid with velvet and inwrought with gold, attracted very universal interest. The mode of testing the sufficient capabilities of steel, when fabricated into swords, was shown in a very complete manner: the sword was screwed tightly by the hilt to a lever, and suddenly, with an immense spring, let descend on a block of hard timber, this trial being repeated on its back, front, side, and edge; if withstanding these shocks, it was considered sufficiently strong, and accepted from the manufacturer at a high price, for the use of our military and naval establishments, while those that broke in their submission to this process were rejected. In conclusion, the lecturer briefly alluded to the properties exclusively belonging to iron, as exhibited by the loadstone in the phenomenon of electricity: illustrations were given of its amazing powers, and its adaptation to our wants cursorily alluded to.

Mining Jour.

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### *Zinc Thread.*

The *Moniteur Industriel* announces that an important discovery in the manufacture of zinc thread has been effected by M. Boucher, who, after many essays, has at length been able to produce zinc threads of any diameter, of great suppleness, and presenting all the qualities of an excellent metal thread. In all cases where great tension is not required, this thread can be substituted with advantage for that of iron, brass, or copper. The price of zinc has doubled during the last few years, but, notwithstanding, M. Boucher vends his thread at a lower price than the galvanic iron thread, and considerably less than brass thread.

Mec. Mag.

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### *On the Corrosion of Metals. By MR. ADIE.*

The object was to give an experimental proof of the fact, of water, when saturated with common salt, preserving, to a great extent, the surfaces of oxidizable metals from corrosion, by the joint action of air and water; and, also, to show that water, or water containing a saline solution, does not act as a corroding agent without the aid of the oxygen of the atmosphere. These positions were demonstrated by the details of several series of experiments which were purely of a chemical tendency, leaving to the engineers the application to practice of the results obtained. The details were also given of some experiments made to ascertain the quantity of oxygen dissolved by water under different circumstances; whence it was shown that brine, and some other saline solutions, contain much less dissolved oxygen than

sea or ordinary water; the discovery of this fact suggested the experiments on the application of brine as a preserver of iron. The object of the last set of experiments was to determine, by trial, the rates of corrosion of metals in fresh water, sea water, and saturated brine. The results demonstrated that sea water corrodes the quickest, fresh water less rapidly, and brine very much slower than either. The circumstance was incidentally mentioned of the use of common salt for preserving ships' timbers, for which purposes the spaces between the ribs of some of the North American ships are frequently packed with rock salt, and the effect has proved advantageous to the duration of the timber, without affecting the metal fastenings, as would have been supposed.—*Proceed. Inst. Civ. Eng.*

Athenæum.

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*On the Air Engine.* By MR. J. STIRLING.

The paper read was by Mr. J. Stirling, and described an Air Engine, invented by his brother and himself. The movements are founded on the well-known pneumatic principle, that air has its bulk or pressure increased or diminished in proportion as its temperature is raised or lowered. The application of this principle was exemplified by drawings, and a model exhibiting a machine composed of two strong tight air vessels, connected with the opposite ends of a vertical cylinder, in which a piston works in the usual manner. Within these air vessels are suspended two air-tight vessels, or plungers, filled with non-conducting substances, and attached to the opposite extremities of a beam, capable of moving up and down alternately, to the extent of one-fifth of the depth of the air-vessels. By this motion of the plunger, the air which is in a heated state below is moved to the upper part of the vessel, and in its transit traverses a series of vertical capillary passages between three metallic plates, which absorb the major part of the caloric. The remainder is taken up by a refrigerator of tubes filled with water. The air at the heated end is about 700 degrees, and has a proportionate pressure; when it arrives at the cooled end it is reduced to about 150 degrees, and the pressure diminished to a corresponding extent. Therefore, as the internal vessels move in opposite directions, it necessarily follows that the pressure of the condensed air in one vessel is increased, while that of the other is diminished. A difference of pressure is thus produced upon the opposite ends of the piston, and a reciprocating motion results, which communicates through a beam, connecting rod, crank, and fly-wheel to the machinery when driven. Machines on this principle were stated to have been worked, for some years past, at Dundee, with considerable saving of fuel, as compared to a steam-engine of similar power, and doing the same work. It is now proposed to adapt it to marine purposes, to which, from its simplicity and slight expenditure of fuel, it appeared well fitted.

Ibid.

*On Benzoline. By DR. FOWNES.*

Pure oil of bitter almonds is converted, by the action of a strong solution of ammonia, into a solid white substance, having a crystalline form, and which was termed by M. Laurent *hydrobenzamide*. The author found that this substance, by the further action of alkalies, became harder and less fusible than before, and not differing in chemical composition from the original substance, but exhibiting the properties of an organic salt-base. To this substance the author gives the name of Benzoline. He finds that the salts which it forms by combinations with acids are, in general, remarkable for their sparing solubility, and that many of them, as the hydrochlorate, the nitrate, and the sulphate, are crystallizable; of the properties of these salts the author gives a detailed account.—*Proceed. Royal Society.*

Ibid.

*On the Solubility of Oxide of Lead in Pure Water. By Lieut. Col. PHILIP YORKE.*

It is from this property that leaden pipes and cisterns become dangerous, when the water which fills them is soft and pure. The lead, however, which the water takes up may be removed by filtering the water through paper; a circumstance which has been explained by supposing that the oxide of lead is not really dissolved in the water, but merely suspended in it. The author, however, shows that the oxide of lead is taken up by the substance of the paper and combines with it, from an affinity such as subsists between the same metallic oxide and cotton fibre; the last taking the oxide from solution in lime-water, and lead being often fixed as a mordant on cloth for dyeing in this way, according to the statement of Mr. Crum. He finds also that the power of the filter may be exhausted, and that therefore it would be unsafe to trust to the action of a filter to separate oxide of lead from water for an unlimited time.—*Proc. Chem. Soc.*

Ibid.

*Experiments on Ozone. By MR. WILLIAMSON.*

The name ozone was given by Schönbein to the substance which occasions the peculiar smell possessed by oxygen gas when produced by the voltaic decomposition of water, and he has made it the subject of much ingenious speculation, concluding that it is a new elementary body, and that it is derived from the decomposition of nitrogen, supposed to be of a compound nature. The last of these opinions, however, has already been disproved by Marignac, who demonstrated that the ozone odor was produced by the decomposition of water free from nitrogen. Mr. Williamson's experiments go to prove that ozone is a compound body, and that one of its elements is hydrogen; for having excluded the last element from any other source, by obtaining the oxygen gas with ozone from the decomposition of a salt of copper, a process in which no hydrogen is generated, and passing the oxygen over metallic copper which had been reduced by carbonic

oxide gas, a sensible formation of water always resulted. The bleaching power of ozone shows it to be a peroxide; and it must therefore be a higher oxide of hydrogen than water, although not the peroxide of hydrogen of Thenard, which is not volatile like ozone, but inodorous and fixed. Mr. Williamson finds also that the substance produced by the action of phosphorus on air is different from ozone, and that its effect, observed by Schönbein in decomposing iodide of potassium and liberating iodine, is the result of the joint action of phosphoric acid and free oxygen upon a solution of that salt.

Ibid.

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### *Time and the Electric Telegraph.*

We have heard of things being done "in less than no time," and always looked on the phrase as a figure of speech signifying great dispatch. This paradox seems, however, to have been actually realized in the case of Wheatstone's Great Western Telegraph, a message having been sent in the year 1845, and received in the year 1844! It appears that directly after the clock had struck 12, on the night of the 31st of December last, the superintendent at Paddington, signalled his brother at Slough that he wished him a happy new year: an answer was immediately returned, suggesting that the wish was premature, as the new year had not yet arrived at Slough! Such indeed was the fact, for "panting" Time was matched against Professor Wheatstone, and beaten half a minute.

Reading Mercury.

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### *A New Glass.*

Styrole is a volatile oil, obtained by distilling the balsam styrax or storax, although only in small quantity, and has a general analogy to benzoin. In one property styrole is, perhaps, the most extraordinary of substances; a limpid fluid at ordinary temperatures, it becomes a transparent colorless glass when heated up to a certain point, and remains so when it again becomes cool—a circumstance which will draw the attention of optical inquirers to styrole. In distilling storax to obtain this liquid, 20 parts of storax are mixed with 7 parts of carbonate of soda, and water put into the retort. In one experiment, 41 pounds of balsam yielded 12 ounces of styrole; in another, 27 pounds yielded 3 ounces. The fresher and softer the storax, the more productive is it of styrole.

Lond. Mech. Mag.

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### *Extracts from the Transactions of the Fifteenth Meeting of the British Association for the Promotion of Science.*

#### *Extracts from the President's Address.*

LORD ROSSE'S TELESCOPE.—The last year must ever be considered an epoch in Astronomy, from its having witnessed the successful completion of the Earl of Rosse's six feet reflector—an achievement of such magnitude, both in itself as a means of discovery, and in respect of the difficulties to be surmounted in its construction, (difficulties which perhaps few persons here present are better able from experience to appreciate than myself,) that I want words to express my

admiration of it. I have not myself been so fortunate as to have witnessed its performance, but from what its noble constructor has himself informed me of its effects on one particular nebula, with whose appearance in powerful telescopes I am familiar, I am prepared for any statement which may be made of its optical capacity. What may be the effect of so enormous a power in adding to our knowledge of our own immediate neighbors in the universe; it is of course impossible to conjecture; but for my own part I cannot help contemplating, as one of the grand fields open for discovery with such an instrument, those marvellous and mysterious bodies, or systems of bodies, the *Nebulæ*. By far the major part, probably, at least, nine-tenths of the nebulous contents of the heavens consist of *nebulæ* of spherical or elliptical forms, presenting every variety of elongation and central condensation. Of these a great number have been resolved into distinct stars, and a vast multitude more have been found to present that mottled appearance which renders it almost a matter of certainty that an increase of optical power would show them to be similarly composed. A not unnatural or unfair induction would therefore seem to be, that those which resist such resolution do so only in consequence of the smallness and closeness of the stars of which they consist; that, in short, they are only optically and not physically nebulous. There is, however, one circumstance which deserves especial remark, and which, now that my own observation has extended to the *nebulæ* of both hemispheres, I feel able to announce with confidence as a general law, viz: that the character of easy resolvability into separate and distinct stars, is almost entirely confined to *nebulæ* deviating but little from the spherical form; while, on the other hand, very elliptic *nebulæ*, even large and bright ones, offer much greater difficulty in this respect. The cause of this difference must, of course, be conjectural, but, I believe, it is not possible for any one to review *seriatim* the nebulous contents of the heavens without being satisfied of its reality as a physical character. Possibly the limits of the conditions of dynamical stability in a spherical cluster may be compatible with less numerous and comparatively larger individual constituents than in an elliptic one. Be that as it may, though there is no doubt a great number of elliptic *nebulæ* in which stars have *not* yet been noticed, yet there are so many in which they *have*, and the gradation is so insensible from the most perfectly spherical to the most elongated elliptic form, that the force of the general induction is hardly weakened by this peculiarity; and for my own part I should have little hesitation in admitting all *nebulæ* of this class to be, in fact, congeries of stars. And this seems to have been my father's opinion of their constitution, with the exception of certain very peculiar looking objects, respecting whose nature all opinion must for the present be suspended. Now, among all the wonders which the heavens present for our contemplation, there is none more astonishing than such close compacted families or communities of stars, forming systems either insulated from all others, or in binary connexion, as double clusters whose confines intermix, and consisting of individual stars nearly equal in apparent magnitude, and crowded

together in such multitudes as to defy all attempts to count or even to estimate their numbers. What *are* these mysterious families? Under what dynamical conditions do they subsist? Is it conceivable that they can exist at all, and endure under the Newtonian law of gravitation without perpetual collisions? And, if so, what a problem of unimaginable complexity is presented by such a system if we should attempt to dive into its perturbations and its conditions of stability by the feeble aid of our analysis. The existence of a luminous matter, not congregated into massive bodies in the nature of stars, but disseminated through vast regions of space in a vaporous or cloud-like state, undergoing, or awaiting, the slow process of aggregation into masses by the power of gravitation, was originally suggested to the late Sir W. Herschel in his reviews of the nebulae, by those extraordinary objects which his researches disclosed, which exhibit no regularity of outline, no systematic gradation of brightness, but of which the wisps and curls of a cirrus cloud afford a not inapt description. The wildest imagination can conceive nothing more capricious than their forms, which in many instances seem totally devoid of plan, as much so as real clouds,—in others offer traces of a regularity hardly less uncouth and characteristic, and which in some cases seem to indicate a cellular, in others a sheeted structure, complicated in folds, as if agitated by internal winds.

Should the powers of an instrument such as Lord Rosse's succeed in resolving these also into stars, and, moreover, in demonstrating the starry nature of the regular elliptic nebulae, which have hitherto resisted such decomposition, the idea of a *nebulous matter*, in the nature of a shining fluid, or condensable gas, must, of course, cease to rest on any support derived from actual observation in the sidereal heavens, whatever countenance it may still receive in the minds of cosmogonists from the tails and atmospheres of comets, and the zodiacal light in our own system. But though all idea of its being ever given to mortal eye to view aught that can be regarded as an outstanding portion of primæval chaos be dissipated, it will by no means have been even then demonstrated that among those stars, so confusedly scattered, no aggregating powers are in action, tending to draw them into groups and insulate them from neighboring groups; and, speaking from my own impressions, I should say that, in the structure of the Magellanic clouds, it is really difficult not to believe we see distinct evidences of the exercise of such a power. This part of my father's general views of the construction of the heavens, therefore, being entirely distinct from what has of late been called "the nebulous hypothesis," will still subsist as a matter of rational and philosophical speculation,—and perhaps all the better for being separated from the other.

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NEBULOUS HYPOTHESIS.—Much has been said of late of the Nebulous Hypothesis, as a mode of representing the origin of our own planetary system. An idea of Laplace, of which it is impossible to deny the ingenuity, of the successive abandonment of planetary rings, collecting themselves into planets by a revolving mass gradually

shrinking in dimension by the loss of heat, and finally concentrating itself into a sun, has been insisted on with some pertinacity, and supposed to receive almost demonstrative support from considerations to which I shall presently refer. I am by no means disposed to quarrel with the nebulous hypothesis even in this form, as a matter of pure speculation, and without any reference to final causes; but if it is to be regarded as a demonstrative truth, or as receiving the smallest support from any observed numerical relations which actually hold good among the elements of the planetary orbits, I beg leave to demur. Assuredly, it receives no support from observation of the effects of sidereal aggregation, as exemplified in the formation of globular and elliptic clusters, supposing *them* to have resulted from such aggregation. For were this the cause, working itself out in thousands of instances, it would have resulted, *not* in the formation of a single large central body, surrounded by a few much smaller attendants, disposed in one plane around it,—but in systems of infinitely greater complexity, consisting of multitudes of nearly equal luminaries, grouped together in a solid elliptic or globular form. So far, then, as any conclusion from our observation of nebulæ can go, the result of agglomerative tendencies *may*, indeed, be the formation of families of stars of a general and very striking character; but we see nothing to lead us to presume its further result to be the surrounding of those stars with planetary attendants. If, therefore, we go on to push its application to that extent, we clearly theorize in advance of all inductive observation.

But if we go still farther, as has been done in a philosophical work of much mathematical pretension, which has lately come into a good deal of notice in this country,\* and attempt “to give a mathematical consistency” to such a cosmogony by the “*indispensable criterion*” of “a numerical verification,”—and so exhibit, as “necessary consequences of such a mode of formation,” a series of numbers which observation has established independent of any such hypothesis, as primordial elements of our system—if, in pursuit of this idea, we find the author first computing the time of rotation the sun must have had about its axis, so that a planet situate on its surface and forming a part of it should not press on that surface, and should therefore be in a state of indifference as to its adhesion or detachment—if we find him, in this computation, throwing overboard as troublesome all those essential considerations of the law of cooling, the change of spheroidal form, the internal distribution of density, the probable non-circulation of the internal and external shells in the same periodic time, on which alone it is possible to execute such a calculation correctly; and avowedly, as a short cut to a result, using as the basis of his calculation “the elementary Huyghenian theorems for the evaluation of centripetal forces in combination with the law of gravitation;”—a combination which, I need not explain to those who have read the first book of Newton, leads direct to Kepler’s law;—and if we find him then gravely turning round upon us, and adducing the co-

\* M. Comte, *Phil. Positive*, ii. 376.

incidence of the resulting periods compared with the distances of the planets with this law of Kepler, as *being* the numerical verification in question,—where, I would ask, is there a student to be found who has graduated as a Senior Optime in this University, who will not at once lay his finger on the fallacy of such an argument,\* and declare it a vicious circle? I really should consider some apology needed for even mentioning an argument of the kind to such a meeting, were it not that this very reasoning, so ostentatiously put forward, and so utterly baseless, has been eagerly received among us† as the revelation of a profound analysis. When such is the case, it is surely time to throw in a word of warning, and to reiterate our recommendation of an early initiation into mathematics, and the cherishing a mathematical habit of thought, as the safeguard of all philosophy.

*Extracts from the Proceedings.*

DENT'S SHIP COMPASS.—Mr. Dent then addressed the section on his proposed method of suspending a ship's Compass. An account of this instrument was communicated to the Association at its last meeting in York. Mr. Dent now read extracts from a report of the working of this compass during six months at sea, as ordered by the Lords of the Admiralty, the amount of which was, that his compass was found "to be extremely sensitive, moving exactly and admirably with the ship's head, when the helm was put hard-a-port and hard-a-starboard: while the other compasses with which it was compared were always in arrear."

Dr. Lloyd asked whether Mr. Dent was aware, that the principle of his suspension bed had been successfully adopted by Mr. Fox, in an instrument which he had constructed for taking the inclination many years since.—Mr. Dent was aware that Mr. Fox had adopted that mode of suspending a dipping needle, for it was he himself who executed the instrument for Mr. Fox; but this was the first attempt,

\* M. Comte, ("Philosophie Positive," ii. 376, &c.,) the author of the reasoning alluded to, assures us that his calculations lead to results agreeing only approximately with the exact periods, a difference to the amount of 1.45, the part more or less existing in all. As he gives neither the steps nor the data of his calculations, it is impossible to trace the origin of this difference,—which, however, *must* arise from error *somewhere*, if his fundamental principle be really what he states. For the Huyghenian measure of centrifugal force  $\left[ F \times \frac{V^2}{R} \right]$  "com-

bined" with "the law of gravitation  $\left[ F \times \frac{M+m}{R^2} \right]$ , replacing  $V$  by its equivalent,  $\frac{R}{P}$  can result in no other relation between  $P$  and  $R$  than what is expressed in the Keplerian law, and is incompatible with the smallest deviation from it.

Whether the sun threw off the planets or not, Kepler's law *must* be obeyed by them when once fairly detached. How, then, can their actual observance of this law be adduced in proof of their origin, one way or the other? How is it proved that the sun must have thrown off planets *at those distances, and at no others*, where we find them,—no matter in what times revolving? *That*, indeed, would be a powerful presumptive argument; but what geometer will venture on such a *tour d'analyse*? And, lastly, how can it be adduced as a *numerical coincidence of an hypothesis with an observed fact* to say that, at an unknown epoch, the sun's rotation (*not observed*) *must have been* so and so, *if* the hypothesis were a true one?

† Mill. Logic, ii. 28.—Also, "Vestiges of the Creation," p. 17.

he believed, ever made to suspend the ordinary azimuth compass in that manner.

**MAGNETIC MACHINE.**—Dr. Scoresby described a large magnetic machine which he had constructed, with some results of its action. The principal part of the machine consists of two cases, or fasciculæ, of magnetic bars, of unusually large dimensions, on principles which may be thus summarily stated: 1. That magnetic bars designed for large combinations, may be conveniently constructed of various pieces; that the separation of a long bar, say of three or four into several portions, is not disadvantageous in regard to power, and that the resulting power is similar, whether in the combining of several series of short bars the elementary bars be of the same or of unequal lengths. 2. That the relative powers of magnets, whether single or compound, when different in mass, but proportional in all their dimensions, are not in the ratio of the masses, the large masses being less strong proportionally than the smaller. 3. That whilst magnets of large dimensions are less powerful with respect to their masses than small magnets to which they are exactly propotional in all their dimensions; and whilst the increase of the dimensions continually deteriorates from the energy due to the mass, yet magnets may be combined in such proportional dimensions with a constant increase of power *ad infinitum*. From this last result, it follows, that magnets indefinitely small must be indefinitely strong; and may indicate that the mutually attractive forces of the ultimate magnetic elements may be as strong as that by which the metallic elements are themselves combined. It must, also, be kept in mind, that the steel should be perfectly hard; and the elementary plates of the magnet should be made of steel, converted out of one or other of the very best qualities of common iron. All the conditions, with the exception of thinness, were attended to in the large magnet constructed by Dr. Scoresby. A magnet on this principle, of the size of the lower mast of a first-rate ship of war, would produce a deviation of nearly 1' at the distance of a mile, and a sensible effect much beyond that. The electrical effects of Dr. Scoreby's magnet with a very imperfect armature were—it decomposed water, rapidly producing about one cubic inch of the gases a minute; with about sixty-five yards of coiled wire, the effervescence seemed as violent as during the action of dilute sulphuric acid or zinc. Copper was deposited from a solution of sulphate of copper at the rate of about 1.2 grain per minute. Shocks and scintillations were thrown out; and sparks were visible in daylight, and emitted audible sounds when the armature revolved so slowly as once in sixteen seconds.

Prof. Forbes had little doubt that Dr. Scoresby could construct very powerful magnets; but he thought that as electro-magnets, so much more powerful, were so readily made, it was almost useless to incur the expense of the others.—Mr. Roberts described a magnet which he had constructed some four or five years since—but as an account was published at the time in the “Annals of Electricity,” we need not report it again.

ON THE ACTINOGRAPH, BY ROBERT HUNT.—After referring to Daguerre's statement that the solar light, two or three hours before noon, was different in its chemical character from that which proceeded from the sun at equal times after it had crossed the meridian, the author proceeded to state from his own researches, that he was satisfied that the amount of chemical power was not in direct ratio with the quantity of light, but that at different hours of the day, and at different seasons of the year, a remarkable variation may be found to exist. The peculiar conditions of plants in the morning and evening, and the phenomena of hybernation, were referred to variations in this chemical (actinic) power, and the processes of germination, of flowering, fruiting, and the autumnal decay of the leaf, shown to be in all probability dependent upon the same influence. This being the case, it became desirable that some *self-registering* means of marking the changes in the condition of the sun's rays should be adopted. The actinograph is intended for this purpose. It consists of a cylinder of brass, upon which is placed a sheet of photographic paper, so prepared with the bromide of silver that all the rays of the prismatic spectrum shall act upon it with equal intensity; over this is placed another cylinder, which is carried round by a clock movement once in the twenty-four hours. In this outer cylinder is a triangular opening, divided by bars into a hundred parts, the smallest part of the slit being one hundred times less than the largest. As this cylinder moves over the paper it is of course exposed for different periods of time to the solar influence over different parts of the divisions; one portion being only exposed for one minute, whereas the largest opening admits of an exposure for one hundred minutes. Thus the greatest intensity of actinic power will produce, during the time of least exposure, the same effect as is produced by the weakest radiations during the period of prolonged exposure. The papers are removed every night and divided into twenty-four parts, and we have hence an exact measurer of the amount of chemical power exerted during every hour of daylight; and as the results may be numerically registered, and the uncertain effects of fixing thus removed, we procure with attention an accurate record for any period of time. This instrument is a modification of one devised by Sir John Herschel, with some improvements suggested by Mr. Jordan. Mr. Hunt stated that circumstances had prevented his doing more than to make a few trials of the apparatus, but that he hoped after the meeting to fix it, and use the actinograph for constant registration.

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GASES FROM FURNACES.—Prof. Bunsen and Dr. Lyon Playfair, (first part of the Report "On the Gases from Furnaces,") "On the eudiometric method of analysis employed in the inquiries on the manufacture of iron, and the gases evolved in the distillation of coal." The authors described in the first instance their method of collecting the gases from the furnaces, which they had succeeded in doing from every part of the iron furnaces, and this in England, Norway, and Sweden. The imperfect state of eudiometry was dwelt on, and the

mode adopted by the authors described; but as the details necessarily involve a number of purely chemical questions, we shall only refer to the more interesting facts. By the improved method the condition of the atmosphere was first ascertained, and the average of many experiments gave as its composition—

Nitrogen,	70.09
Oxygen,	20.91

which is nearly the result obtained by other eminent chemists. The analyses of the various carburetted hydrogens, collected from coal and coke, were next detailed, and many improvements named, particularly that the perchloride of antimony completely absorbed all the carburetted hydrogens, whether the fire-damp, or the olefiant gas, allowing the carbonic oxide and carbonic acid to pass freely, which were afterwards collected and ascertained in the usual manner. The gases proceeding from iron furnaces were found to be—

1. Nitrogen.
2. Ammonia.
3. Light carburetted hydrogen.
4. Olefiant gas.
5. Carbonic oxide.
6. Carbonic acid.
7. Carburetted hydrogen of unknown composition.
8. Aqueous vapor.
9. Hydrogen.
10. Sulphuretted hydrogen.

The gasification of coal in the furnaces takes place in two different points, in the first instance during the distillation of the coal and the formation of coke; and secondly, when the coke undergoes the process of combustion. This result was uniformly observed, and the authors verified it by subsequent experiments on artificial arrangements. The analysis of coal by dry distillation gave—

Coke, . . . . .	68.92
Tar, . . . . .	12.23
Water, . . . . .	7.61
Light carburetted hydrogen, . . . . .	7.04
Carbonic oxide, . . . . .	1.13
Carbonic acid, . . . . .	1.07
Olefiant gas, . . . . .	0.75
Sulphuretted hydrogen, . . . . .	0.75
Hydrogen, . . . . .	0.50
Ammonia, . . . . .	0.17
Nitrogen, . . . . .	0.03
Condensed hydrocarbon, . . . . .	0.00
	<hr/>
	100.00

In the Second part of the Report the practical application will be detailed.

ASHES OF WHEAT.—Mr. W. Sharp noticed that the amount of the ashes of wheat was given from Sprengel as 1.177 per cent., whereas Sprengel himself (page 446, vol. 2, of his “*Chemie für Landwirthe*,” &c.) states it to be 1.777; Dr. Daubeny, on the other hand, gives Sprengel’s analysis as 2.137;—both on the supposition of a misprint in Sprengel’s book. This led Mr. Sharp to undertake some experiments in order to ascertain the truth; and one suggestion arising out of another, about a hundred experiments were performed, with great care, on varieties of red and white wheat, grown on different soils and climates in England, Germany, Sweden, Poland, Holland, and Saxony. Ultimately, answers to the following questions were sought and apparently found:—1st. What is the average amount of inorganic matter in the grain of wheat? From 1.5 to 1.75 per cent. 2d. What is the difference in the result obtained from the combustion of wheat which has been previously dried at different temperatures? A great number of experiments were made by drying at temperatures of 245°, 260°, and 60°, and the difference of result was shown to be considerable. 3d. Can any temperature be recommended as the one to be preferred, at which the materials for these and similar experiments should be dried? The result of the experiment alluded to in the previous answer was in favor of the temperature of 60°. 4th. Can any chemical preparation be added to the substances experimented upon, before or during the combustion, which will facilitate the otherwise tedious process? Several substances were tried, particularly nitric acid, but they all failed to give satisfactory results. The per centage left by nitric acid was always less, but not uniformly less, than it ought to have been. 5th. Does the quantity of inorganic matter bear any relative proportion to the specific gravity of the grain,—that is, to its weight per bushel? The experiments show that a steady *inverse ratio* is maintained between the proportionate weight per bushel and the amount of ashes. Wheat weighing 64 lbs. per bushel yields 1.5 per cent.; and this amount gradually increases, till wheat weighing 58 lbs. per bushel gives 1.75 per cent. 6th. The practical question then follows: How much inorganic matter is removed from the soil of an acre of land by the grain of a crop of wheat? The answer is, one pound per bushel.

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“ON THE VOLTAIC REDUCTION OF ALLOYS,” BY C. V. WALKER.—This communication was intended to explain the methods by which the author has succeeded in throwing down metallic alloys from compound solutions by the action of galvanic electricity. The process adopted, is to prepare a strong solution of cyanide of potassium, and commence electrolyzing it, by means of a copper anode; as soon as copper begins to be dissolved, the copper anode is removed, and its place supplied with one of zinc; after the action has continued for some little time, brass will be liberated on the cathode. The solution is now ready for use, and is operated upon by two or three Daniell’s

cells, and with a brass anode. By similar means alloys of gold and copper, or gold and silver, may be deposited. The author reasons, that true brass is a definite chemical compound; and states—it appears possible that the anode, which is a brass of commerce, is a true alloy, plus an excess of zinc; that the solution it produces is a mixed solution, which consists of the potassio-cyanide of brass and the potassio-cyanide of zinc. This solution is very readily decomposable; it is therefore necessary to prepare it a short time previously to its use. Many specimens were exhibited of copper and other metals coated with brass. The author makes some remarks on the theory of the action; and concludes by stating that it will be quite possible to determine, within certain limits, the character of the alloy that shall present itself, and that we may be enabled to throw down gold and silver according to standard.

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“ON THE INFLUENCE OF FRICTION ON THERMO-ELECTRIC PHENOMENA,” BY PROF. P. ERMAN.—This communication was made by his son, M. Adolphe Erman, who had been invited to the Magnetical Conference.

M. Paul Erman examined the influence which friction at the point of contact of two heterogeneous metals exercises on the needle of a Nobili multiplier, combined with the metals. He then briefly recapitulated the history of this part of electrical science, and resumed by saying, that between the two extremes of electric omnipotence and of electric nullity, which have been attributed to the friction of conductors, he endeavored to find out the mean course of truth. The first step he reached in this career by a great variety of experiments, (on different groups of metals, their primitive temperatures being equal to that of the surrounding space, or lower or higher than it,) was, that the effect of such friction is always like that of an addition of heat to the point of contact. This was shown, among other methods, by the fact that groups of metals which, by difference of temperature, give rise to an electric current of an anomalous weakness or direction, act similarly when rubbed. This applies to galena, sulphuret of molybdena, and some others. In allusion to this intermediate office of heat, our author calls the dynamical electricity produced by the friction of conductors, the tribo-thermic electricity. But now the wonders and paradoxes which happen where things are in the *status nascendi* present themselves once more in this case; but when exerting its tribo-thermic effect, it is neither like conducted heat nor radiant heat. Indeed, its production when friction commences, and its disappearance when friction ceases, prove entirely independent of the mass of the rubbing bodies; and almost independent, also, of the duration of the process which produces it. M. Erman points out, that these remarkable facts seem to be highly favorable to the supposition of a peculiar kind of molecular vibration, excited exclusively in the rubbed points, and spreading through the conducting medium as instantaneously as electricity does. Connected with this fact is a circumstance which M. Erman thinks will be used for the measure-

ment of tribo-thermic effects, almost in the same way as the two fixed points of our thermometers are used for temperature, viz: there exists, for any group of thermo-electric metals, a given positive and a given negative difference, between their temperature and that of the surrounding space, which, when previously existing at the point of contact, continued friction will have no further influence on the electric current. In another part of this valuable paper, M. Erman reports some facts connected with the brilliant discovery of Peltier, that, according to the direction in which it travels, an electric current can as well cool as heat the point of contact of heterogeneous metals. He examined the effect of friction on bismuth and antimony in the four following cases:—

When heated.	When at the temperature of surrounding space.	When cooled.
Antimony.	Bismuth.	
Bismuth.	Antimony.	
	Bismuth.	Antimony.
	Antimony.	Bismuth.

and he found, that the same act of friction produces in these different cases, and with regard to the different metals, at one time a gain of electricity accompanied by a gain of heat, at another time a loss of electricity with a gain of heat; again, either a loss or gain of electricity joined to a loss of heat: and asks, may it be hence inferred that heat when nascent has a property specifically different from that of heat residing in a metal? Are we perhaps on the eve of finding at length something analogous to the brilliant discovery of Peltier, that galvanic electricity produces heat when proceeding from antimony to bismuth; and cold when traveling in the opposite direction? by which M. Lenz has produced congelation. M. Erman's chief object in communicating this paper to the British Association was, to excite British philosophers to engage in this almost new branch of investigation of tribo-thermic electricity. At the same time, he excuses the imperfections of the investigations submitted, by the extreme difficulties of such delicate experiments. Among these, he particularized the almost unavoidable influence of heterogeneous rheophores, which must be joined to the metals under examination. This difficulty caused him wholly to reject the first set of his experiments, until at last he found that the interposition of a plate of pure plumbago between each metal and its conducting wire proves an excellent means for limiting the anomalous production of electricity, without lessening the conducting power of the system. In conclusion, M. Erman suggests an important practical application of this tribo-thermic electricity. Instead of the voltaic apparatus in an electric telegraph, which is variable in its effects and expensive in its application, and may by use get deranged or incapable of action, perhaps at a moment when most required, he proposes to substitute this purely mechanical mode of exciting electricity, so as to affect a distant magnetic needle, and thus transmit signals. It is accomplished by simply removing a dent from a piece of clockwork, when a disk of bismuth rubbing

against one of antimony excites the distant needle. He has tested the method for tolerably long distances.

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“ON THE BARON DE BODE’S INSULATED COMPASS,” BY J. Y. OLIVER.—The object was to insulate the compass from the action of the iron of the ship. The contrivance was this: a double glass bowl, the intermediate space being filled with mercury, was made to act as the bowl of the ordinary compass. It was hung in gymbals, and protected with lead. This rendered it very heavy and cumbrous.

Mr. Dent objected, that if this insulation would protect the needle from the action of the ship’s iron, it would also shield it from the directive force of the earth, and therefore render it useless: but upon placing a poker near the compass, it was distinctly affected through the insulating mercury.

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“ON M. KREIL’S SELF-REGISTERING METEOROLOGICAL INSTRUMENTS,” BY BARON VON SENFTENBERG.—The self-registering instruments of M. Kreil register at intervals of 5’ continually the state of the barometer, of the thermometer and of the hygrometer. The instruments are placed at Prague and at Senftenberg, which is nearly due east of Prague, about 100 English miles distant. It is situated on the Adler, 1281 Paris feet above the level of the sea, in latitude  $50^{\circ} 8' 8''$ , and longitude east of Greenwich  $1\text{h. } 5' 46''$ .98; situated on lias and mica slate, and near higher grounds of granite, gneiss and old red sandstone, and considerable forests. Prague is in a more level country, with the river Moldau flowing through it in a breadth of about 200 fathoms: it is only 524 feet above the level of the sea, without much wood land in its neighborhood; the surrounding hills being lias, sandstone, and argillaceous schist. The Baron then exhibited the dotted curves produced by the instruments, and the curves and mean curves and tables deduced from them; and showed their use, by comparing the curves of Senftenberg with those of Prague, in informing us at which the changes began to occur first; this was readily inferred from the coincidences of the curves after having arrived at maxima and minima;—and concluded by pointing out, as an exemplification of their utility, the curious relations at each place during some remarkable thunder-storms.

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“ON THE STRENGTH OF STONE COLUMNS,” BY MR. E. HODGKINSON.—The columns were of different heights, varying from one inch to forty inches; they were square uniform prisms, the sides of the bases of which were one inch and one and three quarters inch, and the crushing weight was applied in the direction of the strata. From the experiments on the two series of pillars it appears that there is a falling off in strength in all columns from the shortest to the longest; but that the diminution is so small, when the height of the column is not greater than about 12 times the side of its square, that the strength may be considered as uniform, the mean being 10,000 lbs. per square inch, or upwards. From the experiments on the columns one inch

square, it appears that when the height is 15 times the side of the square the strength is slightly reduced; when the height is 24 times the base, the falling off is from 138 to 96 nearly; when it is 30 times the base, the strength is reduced from 138 to 75; and when it is 40 times the base, the strength is reduced to 52, or to little more than one-third. These numbers will be modified to some extent by the experiments in progress. In all columns shorter than 30 times the side of the square, fracture took place by one of the ends failing—showing the ends to be the weakest parts; and the increased weakness of the longer columns over that of the shorter ones seemed to arise from the former being deflected more than the latter, and therefore exposing a smaller part of the ends to the crushing force. The cause of failure is the tendency of rigid materials to form wedges with sharp ends, these wedges splitting the body up in a manner which is always pretty nearly the same; some attempts to explain this matter theoretically were made by Conlomb. As long columns always give way first at the ends—showing that part to be the weakest—we might economize the material by making the areas of the ends larger than that of the middle, increasing the strength from the middle both ways towards the ends. If the area of the ends be to the area in the middle as the strength of a short column is to that of a long one, we should have for a column whose height was 24 times the breadth, the area of the ends and middle as 13,766 to 9,595 nearly. This, however, would make the ends somewhat too strong; since the weakness of long columns arises from their flexure, and increasing the ends would diminish that flexure. Another mode of increasing the strength of the ends would be that of preventing flexure by increasing the dimensions of the middle. From the experiments it would appear that the Grecian columns, which seldom had their lengths more than about ten times the diameter, were nearly of the form capable of bearing the greatest weight when their shafts were uniform; and that columns tapering from the bottom to the top were only capable of bearing weights due to the smallest part of their section, though the larger end might serve to prevent lateral thrusts. This last remark applies, too, to the Egyptian columns, the strength of the column being only that of the smallest part of the section. From the two series of experiments, it appeared that the strength of the short column is nearly in proportion to the area of the section, though the strength of the larger one is somewhat less than in that proportion.

Prof. Challis inquired whether Mr. Hodgkinson had found the columns to give way chiefly in the direction of the cleavages of the stone? Mr. Hodgkinson replied that he had; and that hence the same size and shape of stone cut out of the same block, required very different forces to crush them against the grain from what they did with it. Prof. Stevelly said, that it was one peculiarity of Mr. Hodgkinson's researches, that they opened up so many collateral objects of interest and wide fields of inquiry. It was easy to see that the present researches might become important to the geologist, by leading him to the source from which originated the splitting up of extended rocks into beds and strata, and the contortions of them; for

example, to some volcanic matter forced up vertically in such a manner as to exercise a crushing force upon even distant masses. Prof. Willis showed, by examples deduced from various styles of architecture, that the ancients must have been practically in possession of similar principles; and from several examples which he gave, it would appear that columns of a shape suited to these principles were again coming into use.

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"AN IMPROVEMENT IN THE METHOD OF TAKING POSITIVE TALBOTYPES, (CALOTYPES,)" BY SIR DAVID BREWSTER.—In the method now in use the face of the negative Talbotype is placed directly upon the side of the paper, which has been brushed over with a solution of nitrate, or ammonia-nitrate, of silver, and which is to receive the positive picture. In strong sunlight the picture is thus taken very quickly; but there is a roughness in the shades, owing to the formation of black specks, which destroys the softness of the picture, and in portraits gives a disagreeable harshness to the human face. In order to remove this defect, the author first interposed thin plates of glass, with their surfaces sometimes ground and sometimes polished; but, though the divergency or diffusion of the light, passing through the *negative* picture, produced great softness in the *positive*, yet the outlines were too indistinct, though the Talbotypes looked very well, when placed at a distance. He then tried the effect of interposing a sheet of writing paper, without the water-mark and of uniform texture. The result of this experiment fully answered his expectations. The diffusion of the light thus occasioned shaded off, as it were, all the sharp lines and points, and gave a high degree of softness to the picture. The effect was even improved by interposing *two* sheets of clean paper; and, with a very bright meridian sun, he found that *three* sheets may be used with advantage. A similar effect may be obtained, in a smaller degree, by placing the *back* of the negative upon the positive paper, so as to cause the light to traverse the thickness of the negative, and this may be combined with one or more sheets of clean paper. This, of course, will be appropriate only with portraits; and it has the advantage (sometimes required) of making the figure look another way. To those who see the experiments above described for the first time, the effect is almost magical; and when the negative is removed, we see only a blank sheet of white paper; and our surprise is very great when, upon lifting this sheet, we discover beneath it a perfect picture, which seems, as it were, to have passed through the opaque and impervious screen. Sir David Brewster exhibited specimens of portraits produced in this manner, and also specimens produced by the transmission of light through two perfectly coincident negatives of different degrees of strength; together with specimens of positives, produced by placing the positive paper between two perfectly coincident negatives, and acted upon by light incident on both sides of the picture. Sir D. Brewster mentioned some unexpected theoretical results, which these experiments indicated, but which required further investigation.

Athenæum.

JOURNAL  
OF  
THE FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY.

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OCTOBER, 1845.

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CIVIL ENGINEERING.

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*On the Strength of Wood and Cast Iron.*

Sir,—I had intended to lay before the Mechanical Section of the British Association for the Advancement of Science, at their late meeting at Cambridge, a few remarks on some important points connected with the Experimental Determination of the Strength of Wood and Cast Iron. The fewness of those who attended that Section rendered it advisable to forego this intention; and in fact, by mistake, my paper was described as "On the Strength of Iron Castings," which was not my main object, but merely incidental to the other inquiry "On the Strength of Timber." However, though the meeting of the Section was a failure, I of course met there with Mr. Eaton Hodgkinson, whose labors in the cause of science are so well known, and we had some short conversation on the subject of Cast Iron. He informed me that he had now preparing for publication a great mass of experimental results which would contain results bearing on my views. As, however, it may be some time before we are favored with these tables, and my object is to address the practical man rather than the scientific, I will trouble you to notice the point I wished should be attended to. It was suggested by Mr. Edward Bell, the Professor of Machinery in our College, that by increasing the length of runner head, the strength of a horizontal bar might be made equal to that of a vertical bar, and would be much more uniform in its texture. He therefore prepared some bars for determining experimentally the advantage—and found that it was as he had apprehended. The reason of course is obvious. The iron when in a fluid state obeys the laws of hydro-

statics, and the pressure increases with the depth, and a very small vertical column of iron will produce a great pressure throughout the liquid mass, a pressure proportional to its height. If, then, the column is kept in a state of fusion while the metal in the flask is cooling and setting, the particles will be packed more closely together, the density will be increased, and a stronger bar obtained. In an economical view this is very important, for a very inferior iron will by this means give as strong a bar, or stronger, than a much better, and therefore dearer, iron.

Experiments have been made only on a small scale as yet, but we purpose to extend them in number so as to generalize on the subject, and ascertain whether, by a proper depth of runner head, we cannot make bars of a mixture of Gartsberrie II. and old fire-bars of the worst scrap iron which shall be as strong as the best irons will give.

I had hoped that I should have had time to write a short account of the researches we have made on the strength of timber, but I have found it impossible for the present,—I will only draw your attention to this point. In ascertaining the strength of timber, these two points must be kept quite distinct, viz: the constant expressing the *relative strength*, and the constant to be used in the formulæ, such as those given in Turnbull, which we may call the constant representing the absolute strength.

If a hundred experiments are made on a particular kind of fir, the breaking weight in each case being taken under exactly similar circumstances, the 100th part of the sum of all these weights represents fairly enough the mean strength of that particular wood, *i. e.*, it will do to compare with a number determined in the same way for another kind of fir, and the greater this *mean* weight is, the stronger the wood. So far, then, as scientific research is concerned, this method is fair,—but the same constant will not do for the practical man. I say that for this we must take the *least* weight that broke the beam, and not the mean,—for the workman wants to know not what the average strength of the wood is, but how much he may trust to a particular specimen of it; and therefore he wants to know what is the *least* weight that broke a fair, uniform, sound beam under given circumstances.

The first set of constants will guide him in the choice of his material, but if he begins to calculate the dimensions from the formula, as in Turnbull, he wants a different constant, viz: the one I have above pointed out.

My attention was drawn to this subject by reading the following passage in Professor Barlow's book on Strength of Materials, page 26.

*"Practical Rule.*—Since the strength of direct cohesion must necessarily be proportional to the number of fibres, or to the area of the section, it follows, that the strength of any iron rod will be found by multiplying the number of square inches in its section by the corresponding tabular number as given above.

*"This, however, gives the absolute strength, or rather the weight that would destroy the bar; and practical men assert that not more than one-fourth of this ought to be employed. I have, however, left*

more than three fourths of the whole weight hanging for twenty-four or forty-eight hours without perceiving the least change in the state of the fibres, or any diminution of their ultimate strength."

It will be seen that Professor Barlow uses the expression "absolute strength" in the way in which I have proposed to use "relative strength."

I say that if he proposed the smallest weight instead of the mean, the result would be one which practical men ought to trust. As to the arbitrary "one fourth," it only shows that we have not yet succeeded in proving to practical men that we can do them any good, and Mr. Barlow justly intimates that there is a great sacrifice of the powers of the material in this very arbitrary reduction.

I trust to offer some further remarks on this interesting subject,—as well as to be able to lay before your readers at a future time results of experimental enquiries made by Mr. Ranger, our lecturer and professor of general construction. I hope we shall be able to point out some very important features in the case, to which as yet but little attention seems to have been given.

*College, Putney, July, 1845.*

M. COWIE, *Principal.*  
Civ. Eng. & Arch. Jour.

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*Comparison of English, French, and Belgian Railways. The Fares charged, the Expenses and the Profits.*

While so many railways are in the course of construction, it is interesting to know as exactly as possible every item of expenditure connected with them. An able engineer, M. Julien, under whose direction are the works on the line from Paris to Lyons, has undertaken to give an idea of these expenses. The reports of the railways of France and abroad supply him with materials which he has admirably digested and arranged.

*Average Cost of Railway per mile.*—The first thing that strikes us in M. Julien's Memoire is the observation that the average of 300,000 fr. per kilometre (£19,200 per mile,) generally admitted as the probable cost of construction of the main line in France, *is certainly too small*. Of this M. Julien has given proofs. This is an important consideration at a time like the present, when speculation is so eagerly directed towards railways. On many of the English lines the expense has been from 700,000 to 800,000 fr. (£44,800 to £50,200 per mile. In France we cannot expect the cost to be less than 350,000 to 400,000 fr. on the average (£22,400 to £25,600 per mile.)

*Comparison of Fares charged in England, Belgium, and France.*—On the first view, one would imagine the difference between one railway and another to be so great that it would be in vain to attempt to reconcile them and deduce general laws. The fares, the number of passengers, their distribution among the classes of carriages, would seem liable to infinite variation according to the frequency of trains, the gradients, the curves, and every thing else which has an influence on the expense and profits. M. Julien has, however, in the general

results, collected some very singular coincidences. What can be more dissimilar than the rate of fares in England, France, and Belgium? The fare per mile actually received appears on the average—

	First Class.	Second Class.	Third Class.
*In England,	2.88 d.	1.824 d.	1.2 d.
†In Belgium,	1.20	.88	.56
In France,	1.60	1.20	.80

Then, again, the manner in which the passengers are distributed into the three classes differs very considerably. Of 100 passengers the average proportion in each kind of carriages will be—

In England	18 passengers in the first class,	46 in the second,	36 in the third.
In France	15 “ “	30 “	55 “
In Belgium	10 “ “	27 “	63 “

The total return per mile is in England £2,236, in Belgium £1,160. It is nevertheless a curious fact that the traffic is apparently the same in Belgium as in England, and it is the traffic which affords the criterion of public utility. The Birmingham railway now produces £7,208 per mile; the Orleans line returns are stated at less than £3,200 per mile; M. Bartholomy in a recent work has stated the amount at £2,816; but the Orleans railway will have numerous extensions, and will probably produce one half the return of the Birmingham, with a rate of fare half less, and on the supposition of an equal traffic.

M. Julien has also pointed out another resemblance. The English lines, on the average, derive two-thirds of their revenues from passengers and one-third from luggage, and the proportion is found to be as nearly as possible the same in Belgium.

*Comparison of the Actual Cost of Conveyance in the Three Countries.*—What is most singular is that, on the railways of all countries, the total amount of general expenses corresponding to the running of a train over one kilometre of ground is as nearly as possible 3 fr. (about 3s. 10d. per mile,) and this expense is divided into two equal parts, of which one represents the force of locomotion and the wear of material, the other the expense of management by clerks and superintendents and the general working of the railway.

\* It is singular to observe in the above table that the fare of a third class passenger in England is that of a second class passenger in France and of a first class passenger in Belgium. In the above calculation we have reckoned the centime = 1-10 of a penny, but its real value is at present rather less.—Ed.

† We were much struck with the low charges of railway traveling in Belgium, as compared with those of England. From Antwerp to Brussels for example, a distance of 24 miles, the fares are,—diligences, 3 francs 50 cents; chas-a-bancs, 2 francs 25 cents; and wagons, 1 franc 75 cents; that is 2s. 9½d., 1s. 7½d., and 1s. 4½d.; whereas the same distance upon any of the great lines in England would be above 6s., 4s., and 2s. Upon an average we found it to be only about one-half the expense of similar traveling at home. The consequence is that far more people travel by railway in Belgium than in England. We were astonished at the crowds that went with us in every direction, but more particularly between Brussels and Antwerp, and towards Ghent and Bruges. The increase in the receipts of the different lines has been great, as the advantages have been developed. The lines now in operation were completed in October, 1843; since which time their receipts have increased in an extraordinary proportion. During the past year (1844) the traffic of heavy merchandise was nearly double the amount of the preceding year, amounting to about 500,000 tons. The increase of passengers was still more extraordinary, that traffic alone having realized something not far short, it is said, of 10,000,000 francs.—Ramsay's Belgium and the Rhine.

To express by a clear formula the expense of working a railway, M. Julien has drawn a relation between the goods carried and the passengers who form the principal item of the receipts. The basis of this relation is perfectly plausible. He has accordingly expressed the whole amount of traffic, both for goods and passengers, by a certain number of passengers. His unit of calculation is *one passenger carried one mile*, and all he has to find is the cost of this unit including every expense. He has found that it is—

	Per kilometre.	Per mile.
On the Belgian lines,	2.7 cents	or .432 of a penny.
On the Orleans in 1844,	2.9 “	.464 “
On the Gard in 1842,	2.7 “	.432 “
“ 1843,	2.5 “	.400 “
On the St. Etienne and Lyon in 1843 when the difficulties were peculiar- ly great,	3.5 “	.560 “
On the Strasburg and Basle, the traffic being small,	4.5 “	.720 “
On the English lines, exactly,	4.8 “	.738 “

The last amount however includes the English Government tax, and is accounted for by the smaller number of passengers in each train, for the English companies, correctly or erroneously, prefer a few passengers paying well to a great number paying little: they also have very frequent trains, persuaded justly that what most concerns them is not to spend comparatively little but to obtain a large gross return. If the passengers of an average train were the same in number in England as in France, and if the government tax were equal also, the cost of each passenger per mile would be the same as with us.

*Merchandise.*—According to M. Julien's comparison a ton of merchandise carried by slow trains costs rather more than 5 centimes in France and Belgium, (.8 of a penny per mile,) and in England 7 centimes (1.12 *d.* per mile.)

*Proportion of Expenses to Profits in the three countries.*—With us the Government often, and the committees of the chamber of Deputies always, have admitted as an absolute rule, that on a railway the expense represents 45 per cent. of the returns whatever their amount, from which it is concluded that the net profit is 55 per cent. of the receipts. This opinion has had the unfortunate effect of greatly exaggerating the net profit of poor railways. M. Julien has not had much trouble in proving the inaccuracy of this opinion, all accredited as it is. The more railways are frequented, or, the traffic remaining the same, the more the fares are raised, the greater proportion will the profit bear to the total returns. For there are a large number of constant expenses which have to be incurred *in every case*. On the English railways, which in 1842 gave altogether a receipt of 111 millions of francs, or (£4,625,000,) and an expenditure 48 millions of francs, or (£2,000,000,) the expense was not more than 43 per cent. of the total receipts; consequently the net profit was 57 per cent.: and it would have been as much as 62 per cent. if the English Government tax were as moderate as our own. On the Belgian lines

however the expenses are 60 per cent. instead of 43, and on the Strassburgh and Basle 73 per cent.

In the expenses as stated above, the interest of capital is not included; all that is reckoned is the actual cost of working the lines; otherwise we should have to add in France to the expense a sum of 17,500 fr., or 20,000 fr. per kilometre (£1,120 to £1,280 per mile,) representing an interest of 5 per cent. on the cost of constructing a railway with a double line of rails. And since we can scarcely expect in France an average total return much larger than that of the Belgian lines, which is about 20,000 fr. per kilometre, this item alone swallows up the total receipt.

*Reserve Fund for renewal of rails.*—In the accounts of railways an item ought to be presented which has not hitherto been introduced into them, because the railways are at present new, but which will soon have to find a place: and that is—an annual reserve to collect the capital necessary for a future renewal of rails. How long will the rails last? Twenty years, perhaps, and the crossings and sidings ten or twelve. A double line costs about 80,000 fr. per kilometre (£5,120 per mile.) To form this capital M. Julien proposes to reserve annually 4,000 fr. per kilometre of the line (£256 per mile.) M. Julien is right, and the commissioners have made a great mistake in omitting this consideration in their calculations. The capitalists, if they be wise, and seek, not adventurous speculations, but sound investments, will not commit the same error. On the whole the perusal of M. Julien's Memoir is of the nature to abate any very exalted notions on the subject of railways, and will give valuable information to those about to embark their fortune in those enterprises.

Jour. Des Debats.—Ibid.

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*Prevention of Incrustation in Boilers—Dr. Ritterbandt's process—  
Mr. Johnston's Patent Boilers.*

Sir,—From your remarking on Dr. Ritterbandt's patent, "this has every appearance of being an eminently useful invention, we have never before seen the great evil which it is intended to obviate, grappled within so scientific and effectual a manner," you are evidently predisposed in favour of his invention; yet, from the impartiality you have displayed towards all controversial writings which I have perused in your Magazine for a series of years, I am satisfied that you will find room for the insertion of the following remarks on boiler incrustations.

Scientific men have long labored under the delusion that the deposits in boilers are insoluble, owing to their being chiefly composed of sulphate of lime.

I am much gratified to find that Dr. Ritterbandt and others are now convinced that it is "*the heat employed to generate steam* causing the lime which exists in the water, in the form of *soluble bicarbonate of lime*, to be converted into an *insoluble carbonate of lime*; and (that) in marine boilers, incrustation is generally promoted by the carbonate of lime set free *by the heat*, which, as it floats in the water

previous to subsidence, forms nuclei for the accrescence of other matter, and disposes the saline compounds, such as the sulphate of magnesia, chloride of sodium, *to chrystallize and precipitate much sooner than they otherwise would.*"

These are Dr. Ritterbandt's own words, and he is perfectly right in the opinion conveyed by them, viz, that it is heat which causes the salts, both in marine and land boilers to pass from the soluble to the insoluble state.

The Doctor admits or rather declares, that the heat is the grand cause of the disease; and, in order to alleviate it, he puts into the boiler a quantity of ammoniacal salt. Now in this treatment of the patient I do not agree. Instead of attempting to alleviate, I have succeeded in removing the cause—*the heat*.

The temperature to which water is raised in the act of being converted into steam in a boiler is not sufficient to cause the salts to pass from the soluble to the insoluble state. This change is produced by the *over-heated* state of the metal of the common kinds of boilers; an over-heating which is not at all a necessary accompaniment of the converting of water into steam by the application of fire to a boiler.

The existence of minute globules of steam on the metal of boilers is the cause of its becoming over-heated. By constructing boilers so that currents of water are formed in them, which sweep along the heating surface, and remove from it the globules of steam the instant they are formed, the metal of the boilers never becomes hotter than the water it confines; and consequently, the salts in a boiler thus constructed can nowhere receive that amount of heat which is necessary to make them pass from the soluble to the insoluble state.

I have had a seven-horse power boiler constructed according to this plan, working for the last thirteen months; a portion of that time it was worked with sea-water, and the remaining time with fresh water, which naturally contains a quantity of lime; yet no deposit has ever formed within the boiler.

The fact, that the red-lead paint with which the interior of the furnace and flues were painted thirteen months ago, is still in good condition, is a most convincing proof that the metal never exceeds in temperature the water which it confines.

The subjoined accounts of some experiments on this subject would I think, be new and interesting to some of your readers, if you can find room for them.

Willow Park, Greenock,

JAMES JOHNSON.

July 3, 1845.

*Experiment First.*—Put fifty cubic inches of sea water into a vessel, and place it in a water bath over a fire; the temperature of the vessel containing the sea water can never exceed  $212^{\circ}$  Fahr., as the intervening water of the bath prevents it. After the bulk of the water has been diminished by evaporation until there is only ten cubic inches of water remaining, then allow it to cool, and it will be found that no crystals or hard deposit of any kind has been formed: a considerable quantity of a soft flocculent substance will have settled to the bottom of the vessel; but the slightest motion of the vessel

causes it to move about, and on again applying heat to the vessel the flocculent matter rises up and is dispersed throughout the water. Let the evaporation now be carried on until there be between seven and eight cubic inches of water remaining, and then allow it to cool; it will now be evident, by the existence of a few small crystals, that the water is a saturated solution.

This experiment proves that no hard or injurious deposit will be formed in a vessel in which sea water is evaporated, until the water has become a saturated solution, provided the vessel containing the water be not heated beyond  $212^{\circ}$  Fahr.

*Experiment Second.*—Place other fifty cubic inches of the same sea water in a Florence flask over a gas light for evaporation; after the water has become thoroughly heated it will assume a milky white appearance, and immediately after the flocculent matter will become visible throughout the water, the same as in the first experiment.—Continue the boiling of the water until there is about nineteen cubic inches remaining; if the bottom of the flask be now carefully watched, small specks of a hard scaly deposit will be observed forming; count their number, observe their size, and allow the flask with the water to cool; when cold it will be evident that no increase has taken place in the quantity of the hard deposit, but the soft flocculent matter will have settled down on the bottom of the flask. The specific gravity of the water will now be 1070, and it will float one of Twaddell's hydrometers to the  $14^{\circ}$ . Apply the flame of the gas again to the bottom of the flask; all the flocculent matter will immediately rise up from the bottom and be dispersed throughout the water, without any increase being made to the scaly deposit previous to the water having commenced to boil; but as soon as ebullition has fairly commenced, then the scaly deposit will begin to increase and go on as it did at first.

Now this experiment shows that scaly deposit is only formed during the time the water is boiling, and where the ebullition is greatest.

There is another fact connected with this experiment which I must make known, If the hard deposit was formed in consequence of the water being saturated with matter, it is reasonable to suppose that the deposit would fall to the bottom in a circular or round shape, as the bottom of the flask is spherical, but this is not the shape that it assumes. The gas flame which I used was what is called a swallow-tailed burner; the top surface of the flame next the flask is a flat narrow strip, and, what is very remarkable, this hard deposit inside the flask is formed in the shape of a narrow strip crossing the bottom of it, and exactly coinciding with the flame outside. From this it is evident that the hard scale is formed in consequence of the overheating of the part of the flask acted on by the flame.

\* \* \* \* \*

When the salt water comes in contact with the over-heated plates, they produce or cause a premature crystallization. The process is a production of salt from water which is not saturated.

Can any other circumstance connected with the working of boilers

but the over-heating of the plates be assigned as the reason why the water in marine boilers deposits salt, although it is not a saturated solution?

After a little reflection on these observations, the following question is likely to be suggested, and I shall therefore answer it.

As the salt is produced from water that is not saturated, by the over-heating of the plates; why does the salt not re-dissolve after the producing cause has been removed, by the boiler being allowed to cool?

Now the fact is, that salt thus produced does re-dissolve into the water from which it was taken, provided another change be not allowed to take place; for after that change it is insoluble even in fresh water.

I frequently repeated the second experiment, and in all my trials of it but one, I found that the scale of salt formed, gradually dissolved in the course of twelve hours after the boiling ceased. The trial in which the scale did not re-dissolve at first excited my curiosity, but I soon found out the cause. The person that I sent for the sea-water on this occasion brought it in a rusty iron vessel, and the water had absorbed a considerable quantity of the oxide of iron from it. When the water was boiled, the oxide of iron united with the scale, and formed an insoluble compound. In the other trials pure sea-water was used, and it could receive no oxide of iron from the vessel in which it was boiled, as it was a glass flask; therefore in those repetitions of the experiment the scale dissolved when the water cooled.

Marine boilers are themselves the source whence the scale receives the metallic oxide, and becomes an insoluble compound.

In making the above experiments, I observed that the coating of deposit, after being formed, did not continue to increase in thickness so rapidly as I supposed it would, judging by the rapid manner in which the first coating was formed, and the reason why it did not do so, is owing to the first coating being attached to a firm substance (the glass;) whereas the succeeding coatings required to attach themselves to the first coating, a substance which was, comparatively speaking, soft, and from which it was easy for the bursting bubble of steam to detach portions of the newly-formed scale.

On carrying on the experiments for a length of time, I found that there was a considerable quantity of those detached portions of scale moving about in the water. Now I think it will be admitted, that the same circumstances will occur in marine boilers: viz. that when scale has been and is continuing to be formed in a marine boiler, there will always be suspended in the water minute portions of detached newly-formed scale, and as you are aware that this scale has an affinity for iron, the only conclusion that can be drawn is, that those portions of scale are carried by the ebullition of the water to the comparatively speaking quiescent side parts of the boiler, where they have undisturbed freedom to satiate themselves with their favorite, the iron composing the shell, with which they soon become united in the form of a hard crust.

From a careful inspection of the two kinds of scale, it is evident

that scale from the flues of a marine boiler is of a hard crystalline nature, whereas that from the shell is of a soft, chalky structure,—facts which corroborate my experiments and theory.

I now consider it an established fact, that the premature crystallization in marine boilers, from water which is not saturated with salt, is caused by the local action of the over-heated plates on the water which comes in contact with the plates immediately after each bubble of steam has detached itself from the plates.

Mechanics' Mag.

### *Embankment across the Valley of the Brent.*

Mr. Colthurst exhibited and described,\* three sections of the embankment across the valley of the Brent, at Hanwell, on the line of the Great Western Railway.

The embankment, which was formed of gravel, was 54 feet in height; it rested on vegetable soil, beneath which was a thickness of 4 feet of alluvial clay; then occurred a bed of gravel, varying from 3 feet to 10 feet in thickness, resting upon the London clay which was traversed in all directions by slimy beds or joints.

The surface of the country sloped gradually towards the Brent, which was at a level of about 20 feet below the south side of the embankment.

The subsidence of the embankment commenced during the night of the 21st of May, 1837; the next morning, the foundation was discovered to have given way, and a mass of earth, 50 feet in length by 15 in width, was forced from beneath the north or lower side of the embankment, towards the Brent. For four months this protruded mass increased in dimensions, and the subsidence of the embankment continued, until the surface assumed an undulating outline, which, on being cut through, showed that the subjacent beds corresponded accurately with the curvatures produced at the surface by the disturbance. The state of the seams or strata beneath the surface, was ascertained by sinking trenches at right angles to the embankment.

The symptoms of failure in the embankment, at this period, were confined to a subsidence of about 15 feet, with a fissure extending all along the top of the south slope, at the side opposite to where the foundation had yielded. From the dip of that fissure, Mr. Colthurst inferred the nature and inclination of a rupture of the ground under the embankment.

Immediately on the commencement of the slip, Mr. Brunel directed a terrace to be formed, on the swollen surface, at the north foot of the embankment; the weight of the mass thus placed, succeeded effectually, in stopping the further progress of the subsidence, which up to that period, had exceeded 30 feet. The swollen ground extended over nearly 400 feet in length, by about 80 feet in width, and was elevated nearly 10 feet, with a horizontal movement of about 15 feet. The general disturbance, ranged to a distance of 220 feet from the foot of the slope, towards the river Brent, the south bank of which, was forced forward about 5 feet.

\* At a meeting of the Institution of Civil Engineers, London.

The rupture of the ground beneath the embankment, was indicated by the crack near the upper part of the south slope.

In a letter received recently from Mr. Bertram, one of the engineers on the Great Western Railway, it was stated, that the Brent embankment had subsided very little for several years; indeed, from the nature of the material, there was naturally less sinking, than in loosely formed clay embankments; a coating of ballast from 6 inches to 9 inches in thickness, applied once a year, was found sufficient for all purposes.

The slips which occurred in embankments formed of clay, occasioned trouble at first, by their immediate effect on the road above, and the difficulty of adding material to them. Mr. Bertram had found in many such instances, in the London clay district, that a temporary measure, of forming the softened mass which had slipped down, into large raised beds or ridges from 8 feet to 12 feet wide, by dressing with the spade, surface punning, &c., had the effect of keeping rain-water out, allowing the raised parts to dry, and retaining the mass in its place, until better weather and matured arrangements, permitted the more permanent proceeding of forming an extended footing and working up the mass with additional material, so as to fill up the space with an increased slope.

When the Acton cutting slipped about 3 years since, Mr. Bertram was induced (from the difficulty of bringing gravel to the spot, and the quantity of surplus stuff in the cutting,) to try burnt clay for the drains, for forming an open backing to collect water, and also for mixing with the soft clay in punning up again; from what he then saw, he gave a decided preference to that material, over any kind of gravel, for mixing with clay, to retain it in its place. When gravel was used, there was generally a slight subsidence and opening at the top, but with burnt clay neither occurred. The usual system pursued, was to form with that mixed material, continuous abutments and retvetments, upon the original face, and in all cases to make sure of thorough drainage from the back.

He had always been able to trace an immediate connexion between courses of the septaria and the slips at Acton. Those courses were not sufficiently open to act as natural drains: he had made many surface and deep drains leading from them, but the quantity of water drawn off, was not equal to that which was obtained by the means before described.

At Ruscombe, he had removed the gravel stratum from the top, laying bare and well draining the surface of the clay, using the gravel as a footing or buttress below, at such portions of the cutting as had been forced up by previous slips; when there was under drainage from longitudinal culverts, that plan answered very well.

At that portion of the Sonning cutting, which slipped so suddenly two years ago, the stratum of gravel was found to be broken into, by an upraised bank or dam of clay, which, after much wet weather, kept a reservoir of water penned back, until it broke out the mass of clay, down to the next stratum: the dam had been cut across at different points in the slope for the purpose of drainage, and when that

was done, all that portion of the cutting became particularly dry. A drain was led from the back of the dam in dressing off the slip. That continued to bring away a great deal of water, which previously had some other outlet, over the lowest point of the bank.

Mr. Sibley thought, the causes of the subsidence of the Hanwell embankment were very obvious. In laying out the foundation of the Lunatic Asylum, in that immediate vicinity, and in the formation of a deep sewer, with a soil pit 20 feet in diameter, and 20 feet in depth, at the side of the Brent, he had ample opportunity for examining the strata, and it appeared to him, that had a trench been made in the direction of, and at the foot of the embankment, the marshy piece of land where it was situated, would have been sufficiently drained, to enable it to carry the weight of the mass laid upon it.

The trustees of the Uxbridge Road had their great store of gravel, in fields to the west of this embankment, and excavations had been going on there for about half a century. The springs in that neighbourhood, accumulated in a reservoir which was formed by an escarpment of clay, skirting the river Brent; part of the waste water, together with the percolation from the reservoir, was permitted to traverse the site of the embankment, rendering the ground marshy even in the driest seasons.

The late Mr. M'Intosh had frequently told him, that a larger quantity of material was used in maintaining, than in constructing, the Hanwell embankment.

In answer to questions from members, Mr. Colthurst explained, that the fissures shown in the clay, beneath the embankment, were assumed from the form of the depressions of the surface. The sections of the ground were taken weekly, during the whole time of the subsidence, so that he contended, the form of the substratum might be assumed as being correct.

The spreading of the lower side of the embankment, displaced the bank of the river Brent for some distance.

Sir Henry Delabèche remarked, that if the sections which were exhibited, approximated to truth, it would appear, that the embankment was formed upon a fault of greater magnitude than usual. The consequences were inevitable; when the fault yielded, the embankment sunk, and continued to subside, until the mass was stopped by weighing the foot, and thus restoring the equilibrium.

Mr. Colthurst said, that the slimy beds, and the fissures, which ran in all directions in the clay, were most difficult to be guarded against, and they were, he believed, the principal causes of slips and subsidences.

Mr. Braithwaite said, that from the observations of Sir Henry Delabèche, it might be inferred, that slips and other movements of earth, were more frequently due to mechanical, than to chemical action, although in the case of the New Cross slip, the latter had been much insisted upon.

Mr. John Braithwaite gladly availed himself of the geological knowledge of Sir Henry Delabèche, and his approbation of the measures pursued was highly gratifying to him.

With respect to the Brentwood cutting, although the strata were nearly horizontal, and it might have been imagined, that there would be little tendency to slip, yet from the ground being so full of water, more than ordinary attention to its drainage was required, for it was so retentive of moisture, that a drain had but little influence at a few yards from it.

The draining shafts which were sunk, had operated well, to the extent to which they were carried, and he believed that generally, the mode of treating the Brentwood cutting was considered successful.

He had understood, that the trenches which had been alluded to, had not been extensively used.

Mr. Phipps explained, that the trenches and the wall with dry backing, were tried under his direction merely as an experiment, prior to the examination of the ground by Sir Henry Delabéche. The dry shafts were subsequently sunk, and the only doubt he entertained was, whether there was a sufficient number of them to drain the bank effectually.

Sir Henry Delabéche said, there could not be any doubt of the ground being completely drained, if a sufficient number of shafts were sunk to intercept the water, but then the question of their cost must be considered.

In answer to questions from the President, Mr. Green stated, that his experience did not enable him to lay down any rule for the prevention of slips in cuttings or embankments. They were generally to be attributed to the presence and pressure of water, acting upon the substratum; the method of discharging the water must depend on the direction and nature of the strata; in all ordinary cases, he conceived, that with proper application of the known methods of drainage, successful results might be attained.

He had not made any particular observations, as to the relative duration of the tendency to slip, exhibited by the slopes of embankments and cuttings, in canals and railways; but he conceived, that in a canal, the weight of the water acted as a support to the internal slopes, and tended also to counteract the upward pressure of water in the substrata. He had frequently observed this in cuttings, with embankments on the sides; while the canal was full of water, the banks stood well, but when the water was drawn off, the banks subsided, and the bottom of the canal rose up.

A curious instance occurred in forming part of the Exeter ship canal, through mud lands in the estuary of the Exe. The embankments on the sides of the cutting remained firm, so long as their weight only just balanced the upward tendency of the water in the substratum of the bed of the canal; but when the increased weight of the mass destroyed the equilibrium, the embankments sunk down, and the bottom of the canal was forced up in proportion.

This occurred in several places, even after the works had preserved a perfect section for some months; but the canal had not then been filled with water. It was found, on examination, that at a few feet only below the bottom of the canal, there existed a bed of peat, which, although capable of resisting the weight of the banks for a considera-

ble time, at length gave way; thus the embankments sunk down, the bottom of the canal rose up, and it became necessary to drive strong piles in the line of the bottom of the canal, on each side in a lateral direction, and to support these piles by rough inverted arches of stone, at intervals of about 20 feet, for a considerable distance; after which, the banks, being slowly raised, stood well.

The President said, it must have been observed by all engineers that in the embankments and cuttings of canals, the slips generally occurred within the first six or eight months after the works were completed; but in railway works, the slips constantly occurred even after years had elapsed. He observed on many of the railways on which he habitually traveled, that the slopes were almost as frequently under repair, after being open for many years, as they were within a few months of the first opening. He was decidedly of opinion, that, although water might be the primary cause of the slips, the vibration caused by the passage of the trains, was the more immediate cause.

When, as had been so ably explained, the lower beds became converted into mud, and the adhesion of the particles was destroyed, the mass only required a slight impulsive force, such as the vibration consequent on the passage of an unusually fast or a very heavy train, to set it all in motion and to cause a slip.

Some of the methods proposed for the formation of embankments, such as only constructing them during suitable weather, and with thin layers of material regularly laid and pounded, &c., might be used in the construction of reservoirs for containing water; but they were not compatible with the manner in which extensive works required to be carried on, independent of the extra cost they would occasion. Experience had shewn him that the best method of constructing a heavy embankment, was, to run forward two tips, parallel with each other, forming the outsides of the bank, and leaving a void in the centre which was subsequently filled up. The greatest amount of pressure was thus brought to act vertically upon the material, and the two sides having become somewhat consolidated, were better able to resist the pressure, and they had not any tendency to slip away.—This method had been ably treated by Mr. J. B. Hartley, in a paper read before the Institution some years since.

He had not found any difficulty in inducing contractors to adopt that method; when proper precautions were taken to insure thorough drainage, he believed that embankments would, generally, stand well, although made in the wettest weather. Moisture would only cause the mass to become more consolidated; and, when that was once the case, but little water would subsequently percolate.

He concurred in the opinion, that the gravel counterforts acted rather as drains, than as supporting buttresses; for he believed, that they stood, generally, at a steeper angle than the slopes which they were supposed to support.

Mr. Clutterbuck said, in confirmation of the President's opinion, he had been told by the persons who worked in the sand-pits, under the plastic clay, near the London and Birmingham Railway, that they

were afraid to remain underground during the passage of the heavy luggage trains, on account of the extreme vibration of the earth.

Mr. Green was convinced of the correctness of the President's opinion, as to the effect of vibration upon banks saturated with water. He had seen instances, even in canal embankments, where, at the head of locks, the vibration arising from the sudden and careless closing of the lock-gates had produced slips.

He did not think any commensurate benefit would result from the extra expense of pounding the earth in embankments, as had been suggested. The degree to which earth might be safely consolidated, by pounding, could only be determined by great attention to the nature of the material, and to the circumstances under which it was used. He had known much injury caused by the earth backing for walls, being too much pounded, when, from defective drainage, the expansion of the earth had, subsequently thrown the walls down.

Mr. Hughes presented a specimen of Watson's drain pipes. They were made of Staffordshire clay, which possessed great strength and durability; and they had also been made of cast iron. The apertures in the periphery were enlarged, inwards, so as to prevent the possibility of their choking up. The holes were so small that but little earth could be carried in with the water; but, if any did enter, it fell through into the body of the pipe, and was washed out by the water. The drain tile also having the same kind of apertures.

These pipes had been successfully used, for some time, in the cuttings of the London and Birmingham, and the Croydon railways; and Mr. Hughes promised to give, during the next session, a report of the method of using them, and of the result of their application in several wet cuttings.

Jour. Arts & Sci.

*First Annual Report of the Directors of the South Carolina Railroad Company, for the year ending December 31st, 1844.*

Continued from page 164.

Extract from the Report of the Committee of Seven, to which was referred the Annual Report of the Directors of the South Carolina Rail-Road Company, and the accompanying documents.

The next matter to which your committee will direct your attention, is that portion of the report, which refers to the construction of a Rail-Road to Camden; and also, to the resolutions from your Board of Directors on the same subject, which recommend that you accept the Act of the last session of the Legislature, for the construction of a Branch to Camden. Your committee, being deeply impressed with the importance of this work, to all concerned, that is the Stockholders, the City of Charleston, the Town of Camden, and all that large portion of country that will be enabled to avail itself of the advantages of the Road, and all those whose business connexions are, or may be, with Camden, by which they will be furnished with a better market, both to sell and buy in, recommend that you adopt the resolutions of the Board. As this is a grave question, and one involving the expenditure of a large amount of money, we presume, it will be expect-

ed of us that we should furnish the data, upon which we have come to the conclusion, that it is the interest of all the parties above-named, that this work should be undertaken. We will proceed now to do so, and as you are assembled to look after your own business, and as your interest should be the prompting motive to accept the Act of the Legislature, we will in the first place endeavor to prove, that it is the interest of this company to do so. And with that object, we will submit an estimate of the probable income and expenditure, assuming that the Road will cost \$500,000, which in the present state of our information, is as probable as any other sum. One of the estimates of the Engineer, being below that amount, and the other, for near a corresponding amount above it;\* and the highest of the estimates referred to, would be reduced within this sum, provided the Federal Government should reduce the duty on iron, before the time at which it is required. The estimate of income and expenditures is

Transportation of 50,000 bales of cotton,		
at 75 cents per bale,	-	\$ 37,500 00
Up freights equal to those down,	-	37,500 00
12 passengers up and down daily, at \$6,	-	52,560 00
For carrying the small mail,	-	4,000 00
		<hr/>
Gross Income,	-	\$ 131,560 00

*Items of Expenditure.*

Interest at 7 per cent. on cost of road,		
estimated at \$500,000,	\$35,000 00	
Repairs of 40 miles of road, at \$300		
per mile, per annum,	12,000 00	
Expenses of work-shops including		
workmen, and all materials on 204		
miles, is \$60,000, on 40 miles at the		
same rate, is	11,220 00	
Daily expenses of one passenger's car,		
to the main Item, is \$8.50; per an.,	3,102 00	
Expenses of a train of freight cars		
from Camden to Charleston, per trip		
of 3 days, \$29.25; per annum is,		
allowing for 100 trips per annum,	2.925 00—	64,247 00

Nett profits of Branch, is	-	\$67,313 00
This would be within a small fraction		
of $2\frac{2}{3}$ per cent., on all the present		
stock of \$2,604,000. But suppose		
the above estimate of passengers, to		
be too large, and we deduct one-		
half, say, leaving only 6 daily,	-	26,280 00

Nett profit is,	-	\$41,033 00
Or $1\frac{2}{3}$ per cent. on all the stock, say \$2,604,000.		

\* The amounts depending on the kind of iron rail which may be adopted.

If the above estimates of the income of the road be correct, there can be no doubt of the propriety of construction, and these your committee will now consider somewhat in detail. First, of the 50,000 bales of cotton. As to this item, it is within the personal knowledge of some members of your committee, that the amount of cotton to be brought within the reach and influence of this road is nearer 70 than 50 thousand bales; in fact, Camden and Wright's Bluff, alone, would furnish the quantity, without taking in some 20,000 bales that are shipped at intermediate points, or wagoned to this market; and also, without making any allowance for the large accession of cotton, which would be brought to Camden, and which is now sold in Cheraw, and is thence shipped in part to Charleston, but principally to New York by the way of Georgetown. As there is no doubt of this being the quantity of cotton, the question arises, will the Rail-Road obtain the transportation of it? of this, there cannot be a question, at the rate of freight assumed by your committee, that is 75 cents per bale. The present rate of freight from Camden to Charleston, is \$1 per bale, which is the lowest it has ever been for any season, and is as low as it can be brought by boat. No boatman can long continue to bring cotton, from Camden to Charleston, at 75 cents per bale. But in competition with the Rail-Road, he could not get even this, as the Rail-Road insures the delivery of cotton upon it; and to procure such insurance, either the boatman or the owner of the cotton, would have to pay 10 cents per bale for insurance: which would require the boat owner to carry at 65 cents per bale. Besides, the road would even at this rate have the preference, as it would deliver the cotton with greater certainty, and at a saving of time.

As to the second item of income, experience leaves us no room to doubt, that the up freights will always exceed those down. The Committee have had before them, the Reports of the Road from 1834 to 1845 inclusive, being eleven years, and embracing in those eleven years, every variety of seasons, and periods of the greatest commercial and agricultural prosperity and depression; so that, all reasonable tests have been applied, by which we can judge such a question; the result is well worth consideration. A table is appended to this report, headed "Freight Statement," which shows the operations of each of these 11 years, and from it, we find, that in that period

The up freights have yielded an income of	\$1,208,336.19
The Down freights       "       "       "	786,679.04

Showing, excess of up freights over down freights of \$421,657.15

Averaging during these eleven years, an excess of income from up freights over down freights, annually, of \$38,332.47 being very nearly 57 per cent.

It is not, however expected, that this disproportion will continue; it has in fact diminished in the last two years and a half, not from diminished up freights, but from increased down freights, the road having brought greatly increased quantities of cotton and other heavy articles down, during that time. The wise policy of the Directors, in

lowering and affording every facility for bringing down the cotton and other produce, while it has increased the income greatly from down freights, has added considerably, but not in the same ratio, to the up freights. The same results, perhaps more favorable ones, may be expected from this Branch—the *very least* that can be counted on, is an equal amount, which the Committee has assumed.

### FREIGHT STATEMENT.

*From 1st Jan. to 30th June.*

*From 1st July to 31st Dec.*

AMT. UP.		AMT. DOWN.		AMT. UP.		AMT. DOWN.	
1834	\$19,553 31	\$9,701 49		1834	\$37,054 15	\$ 18,503 49	
1835	35,553 15	12,630 50		1835	53,683 90	29,915 39	
1836	51,906 00	19,288 13		1836	49,428 96	19,410 75	
1837	35,038 02	10,543 24		1837	49,919 65	42,768 26	
1838	51,558 24	25,458 45		1838	58,438 48	26,936 55	
1839	52,203 39	17,306 45		1839	70,573 02	57,240 64	
1840	61,198 18	57,193 89		1840	49,534 28	20,577 19	
1841	46,730 98	28,610 09		1841	59,219 66	27,425 20	
1842	67,248 36	23,134 28		1842	64,741 05	72,741 33	
1843	61,680 25	53,471 87		1843	67,656 42	65,052 88	
1844	71,631 02	54,487 54		1844	85,755 72	94,281 43	
\$562,330 90		\$311,825 93		\$646,005 29		\$474,853 11	

As to the third item of income, that is from passengers, your committee believe, that the larger estimate will be the one which will be found to be correct, as it will open to the road, all that portion of the state below Camden, and east of the Wateree river; and which is now measurably deprived of the facilities of the same, even though within a distance to reach it, as there is no bridge over that river from Camden down; nor is there a ferry, which at all times can be crossed, nearer than Vance's, which is 60 miles below Camden, and too far south, to offer an inducement to go to the road. The influence of this road, would also command considerable travel from Cheraw, or the Pee Dee section of country, and from North Carolina, which your committee believe would give the higher estimate of passengers, but unquestionably the lower, that is 6 passengers daily.

The item for the transportation of the Mail is the lowest rate that can occur.

As to the expenses of the road, the first item of \$35,000 speaks for itself, being the interest on the estimated cost of the road, say \$500,000; and as to the other items, they are all taken from the books of the company, and are of unquestionable authority.

Your committee for the foregoing reasons, have no hesitation in recommending to the company to accept the Act, so far as the interest of the company is concerned.

Statement of the number of *Passengers conveyed upon the Railroad between Charleston, Hamburg and Columbia, with the amount received for Freight and Passage, from 1st January to 31st December, 1844.*

PASSAGE.						FREIGHT.			
	UP.		DOWN.		UP AND DOWN.		UP.		TOTAL AMT. NT.
	No. Pass.	Amount Passengers.	No. Pass.	Amount Passengers.	No. Pass.	Amount Passengers.	Amount of Freight.	Amount of Freight.	
January.....	2,277	7,342 83	1,804	6,265 27	4,081	13,608 10	11,067 36	26,420 74	40,028 84
February.....	2,455	8,388 16	1,926	7,949 92	4,381	16,338 08	12,543 79	28,529 69	44,867 77
March.....	2,750	9,718 20	1,906	7,015 55	4,656	16,733 75	19,077 76	26,634 97	42,368 72
April.....	5,556	9,581 92	5,365	8,977 13	10,921	18,559 05	13,454 48	18,014 69	36,573 74
May.....	2,106	7,123 68	1,996	6,770 75	4,102	13,894 43	9,128 63	16,023 71	29,918 14
June.....	1,690	5,870 06	1,521	5,185 75	3,211	11,055 81	6,359 00	11,494 76	22,550 57
Total for first half year.....	16,834	48,024 85	14,518	42,164 37	31,352	90,189 22	71,631 02	126,118 56	216,307 78
July.....	1,663	5,412 22	1,442	5,073 60	3,105	10,485 82	5,986 52	9,918 14	20,403 96
August.....	1,584	4,980 11	1,502	5,104 73	3,086	10,084 84	7,355 69	12,780 11	22,864 95
September.....	1,674	6,792 48	1,326	4,534 78	3,000	11,327 26	20,521 56	29,734 58	41,061 84
October.....	2,532	10,317 70	1,843	6,848 31	4,375	17,166 01	26,001 92	53,285 04	70,451 05
November.....	2,267	9,101 27	1,779	7,157 14	4,046	16,258 41	15,985 97	40,705 53	56,963 94
December.....	2,810	8,443 42	2,372	7,563 10	5,182	16,006 52	9,904 06	33,613 75	49,620 27
Total for second half year.....	12,530	45,047 20	10,264	36,281 66	22,794	81,328 86	85,755 72	180,037 15	261,366 01

INCOME FOR FIRST HALF YEAR.		INCOME FOR SECOND HALF YEAR.	
Income from Freight and Passage as above, first half year,	\$ 216,307 78	Received for Passengers and Freight, second half year,	\$ 261,366 01
“ Mails, Rents, Storage, &c.,	27,727 36	Tickets from Hamburg to Charleston, sold by the G. R. R. Co.	2,798 50
		Carrying the Mails,	20,149 98
Total,	\$ 244,035 14	Freight not included above,	199 50
		Transportation of iron for the Geo. R. R. Co.	2,853 63
		Rents, storage, oak wood sold, &c.	1,467 19
		Total,	\$ 288,834 81



## AMERICAN PATENTS.

*List of American Patents which issued in the month of January, 1845, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For an improvement in the *Press for Pressing Cotton*; William Bullock, Jersey City, New Jersey, January 4.

The patentee says—"The nature of my invention consists of an arrangement of a compound lever, in combination with an arrangement which is so contrived as to release the pressure after it has arrived at a certain limit, so as to have an uniformity in all the bales to be pressed."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of levers K, K, with the side links P, P, and with chains Q, Q, passing over rollers R, R, having vertical links to support the movable platen. I also claim the invention of the arrangement for connecting the self-adjusting platen to the machinery, by which the power is applied to the press, so that whenever it takes beyond a limited amount of power to propel the press, the simple action of the power in propelling the press will release the bale, until only the given amount of power is required. And I also claim the invention of the arrangement for connecting the above arrangement for adjusting the power upon the bale to the movable platen of the press, substantially in the manner and for the purpose set forth."

The main levers of the press, designated in the claim by the letters K, K, are jointed at each end to links P, P, attached to chains that pass over rollers, and are then connected with the lower (movable) platen by other links. The fulcra of these levers (they are not levers but four arms projecting from a shaft, two at each end) are in the middle of their length, so as to draw up both ends of the platen with equal velocity, and the lever that operates the whole press is their shaft. The rollers over which the chains Q, Q, pass have their bearings in horizontally sliding pieces attached to the frame above the bed of the press, and these are kept apart by a wedge-formed block on each side of the press, the upper ends of which bear on the periphery of an eccentric sector attached to the shaft of a segment cog wheel, the teeth of which take into the cogs of a pinion wheel on the arbor of a friction or brake wheel, having a friction band passing around a portion of its periphery and connected with a spring. By this arrangement it will be apparent that when the power applied to the lever of the press is too great, the rollers Q, Q, will slide inwards, force up the wedge-formed blocks, and turn the friction brake instead of drawing up the platen, so that by increasing or decreasing the tension of the spring on the friction belt of the brake, the amount of force which the bale will receive can be regulated at pleasure.

2. For improvements in the *Printing Press*; John L. Kingsley, New York city, New York, January 4.

The patentee says—"In my improved press the inking apparatus, and that for making the impression, are in their general construction, similar to those employed in the most improved machines, but they are so modified and arranged as to adapt them to an entirely new apparatus for conveying the sheet to the required positions for printing them on both sides, or what is technically called perfecting the sheets; which is done before the sheets leave the gripper, by which they are deposited correctly in a pile ready for drying. By this arrangement, one person is required to feed the machine by supplying the sheets to be printed, the press being actuated by any adequate power.

In a machine thus arranged, one half the labor of feeding required in the best registering machine with which I am acquainted, namely, that of Tuft's, of Boston, is saved, and with the employment of two persons at the feeding board; his press affords only about six hundred impressions in an hour, whilst, as my machine takes two impressions to one sheet supplied, and the printed sheet is deposited without interfering with the feeder or feeding, it may be run at any speed which allows time merely for the inking and the supply of sheets, and may consequently make from twenty to twenty-five hundred impressions in an hour. My machine secures a perfect register, as the sheet which has been fed in the gripper does not leave them until it is perfected, when it is deposited as hereinafter described."

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the arrangement of the grippers combined with the carrying belts, by which I am enabled to carry in the paper, hold it, and retain it until it is perfected, by which it prints it on both sides and then deposits it; the operations being effected by so combining the sheet apparatus with the inking rollers as to give the carrying belts and grippers an intermitting progressive movement, as described.

I also claim in combination with the printing apparatus, the so arranging of the carrying belts as to return the sheets of paper which have been printed on one side at nearly the same level which they occupied when they received the first impression, they being in both cases at the proper elevation for giving the impression as described.

I claim likewise, the manner in which the grippers are made to open and close by means of a spring operating to force and hold them open, and bolts for holding them when closed, in combination with the closer and opener, substantially as set forth."

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3. For an improvement in the *Cylinder Brush used in the Saw Gin for ginning Cotton*; Ebenezer Carver, Bridgewater, Plymouth county, Massachusetts, January 4.

The patentee says—

"The design of my improvement is to enable the brush to produce a sufficient and regular current of air through the gin so as to dis-

charge the clean cotton through the machine in a better manner than has heretofore been done.

In the operation of the common gin, the brushes usually employed for taking the cotton from the teeth of the saws and discharging it through the gin, are liable to produce eddies and counter currents of air in the gin which interrupts the regular and direct passage of cotton through the machine, and causes it sometimes to collect at the ends of the brush in such quantities as to retard its motion and endanger the machine.

This difficulty I obviate by the application of what I call fans to the ends or heads of any cylinder brush extending from the axis to the outside of the cylinder and standing out or projecting from these heads from one to two or more inches according to the length of the brush.

Claim.—“ Having thus described my improvement and its advantages, I now claim as my invention and desire to secure by letters patent, the combination of a cylinder brush having fans on the end thereof, with a cotton gin for the purpose and in the manner herein set forth, or in any manner substantially the same.”

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4. For improvements in *Stoves for Heating Apartments*; Henry Stanley, Poultney, Rutland county, Vermont, January 4.

Claim.—“ What I claim as new, and desire to secure by letters patent, is the manner in which I have combined and arranged the two stories thereof, consisting of two cylinders, with eight triangular radiating flues arranged around, and in contact with them, said flues communicating with the flue space in the plinth, with the intermediate chamber, and with the cornice space, as described; the two latter being divided by partitions into anterior and posterior portions, in the manner and for the purpose set forth; and there being also openings, such as are herein described, and represented, through the upper end of the upper cylinder into the cornice space, in the manner and for the purpose above made known; it being distinctly understood, that I do not make any claim to either of the individual parts taken separately and alone, but that I limit my claim to the combination and arrangement thereof as a whole: not intending however, by this claim to confine myself in constructing my stove to the particular form of the respective parts as described and represented, but to vary these as I may deem expedient, whilst I attain the same end by means substantially the same.”

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5. For an improvement in the *Cooking Stove*; Charles Wolff, Cincinnati, Ohio, January 4.

Claim.—“ What I claim as my invention, and desire to secure by letters patent, is the two horizontal flues, in combination with the ovens, their bottom plates forming parts of the top of the oven, their inner plates forming partly two sides of the same, their top plates being formed by the hearth plate, and their outside plates by the side plates of the stove. I do not claim merely to conduct the heat

all around the oven, but I do claim the particular arrangement of the flues to effect the said object as herein above described.

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6. For an improvement in the mode of *Arranging a Reciprocating Steam Engine to turn two parallel shafts*; J. H. Towne, Philadelphia, Pennsylvania, January 10.

The following is extracted from the patentee's explanation, viz:—"The engine is to have a vibrating cylinder, sustained upon suitable trunnions, through which, if desired, the steam may be admitted into the cylinder, but it may, if preferred, have other provisions for the admission of steam, which need not be described, as it is not intended to make claim to any particular manner of doing this, but to use such as are already known, or which may be hereafter devised.

In my engine there are to be two piston rods in a line with each other, which rods are to pass through the two cylinder heads, each head being provided with a stuffing box. The piston rods are each to be connected with a crank at their outer ends, so that each actuates the shaft of a wheel for propelling, or for any other purpose, and cause said shaft to revolve in opposite directions.

One of the connexions of the piston rod with its crank is to be made by the aid of a link, or of a sliding box, admitting of a slight degree of lateral play, to prevent cramping as the cranks revolve."

Claim.—"I claim therein as new, and desire to secure by letters patent the manner in which I have arranged the same so as to connect two piston rods, proceeding from one piston to two driving shafts, for the purpose of turning them simultaneously in the opposite direction as set forth. I likewise claim in combination with the two piston rods, the connecting of one of them to one of the crank pins, by means of a link, or some equivalent devise, allowing of the amount of the lateral motion necessary to enable both cranks to revolve with perfect freedom.

I do not claim the passing of the two piston rods through the two heads of a cylinder, as in itself new, this having previously been done; but I limit my claim to the combination and arrangement by which I effect the object that it was the purpose of this invention to accomplish, as set forth, and applied to the vibrating cylinder steam engine."

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7. For an improvement in the machine for *Planting Potatoes*, Enoch Woods, Beloit, Rock county, Michigan, January 10.

This machine consists of a plough for opening the furrow, two reversed mould boards, for forming the ridges, a hollow tooth for opening the drills and conducting the seed to the drills, and these are all followed by coverers and a roller. The planting apparatus consists of a pricker which pricks into the potatoes, lifts them up from the hopper, and carries them against a scraper by which they are removed from the pricker, on its back movement, and dropped into the tube of the hollow tooth and thence conducted to the drills. The lever of the pricker is operated by pins on a wheel, receiving its motion by a belt from the axle of the carrying wheels.

Claim.—“What I claim as my invention, is the combination of the apparatus for dropping or planting potatoes, with the apparatus for ploughing the ground, opening the drills, and covering the seed, as described.”

8. For a machine for *Backing Books, for Book-binders*; William Loughton, Portsmouth, Rockingham county, New Hampshire, January 10.

The patentee says—“The operation of backing consists in giving that roundness or convexity to the back of the book which is necessary to prepare it for the reception of the covering of leather or other material. This process is usually performed by confining the book after it has been stitched and cut, between suitable boards or plates of metal, which are pressed firmly together by means of screws, and the back is then hammered into the desired form. In my machine, the book to be backed is confined between two plates, or jaws of iron, which is made to clasp it firmly, as if between the jaws of a vice, and these plates are so arranged as when closed to constitute a carriage, which, by means of a rack and pinion, is moved on in a straight line, so as to bring the back of the book against a roller, or against a block of iron, or other metal; when a roller is used it is made hollowing or concave on its periphery, and is so adjusted as to force the back of the book to assume the desired convex form, leaving it perfectly straight from end to end, and giving to it an equal convexity in all its parts. When, instead of the concave roller above named, I use a block of iron or other metal, which is made to occupy the place of the roller, said block has that side of it which is towards the back of the book, made concave, or hollowing lengthwise, and the back of the book as it is passed along being made to press against the block, receives the desired form; this latter manner of forming the instrument possesses some advantages over the roller, and will probably be generally preferred.

Claim.—“What I claim therein as new, and desire to secure by letters patent, is the manner herein described of causing the back of such books to be carried along against a fluted roller, or block of metal, whilst they are confined between the jaws of what I have herein denominated the backing irons, the respective parts of said machine being arranged and operating substantially as herein fully made known.”

9. For an improvement in machinery for *Making Pelisse Wadding, or Batting*; Oliver Tenny, Dorchester, Norfolk county, Massachusetts, January 10.

In this machine the bat is sized without an endless apron. It passes directly from the sizing rollers over a small roller at one edge of a vertical chamber, descends nearly to the bottom thereof, and then up again over another roller at the other side of the chamber, and is there delivered and rolled up. A stove is placed at the bottom of the chamber and communicates by a pipe with a long drum near the top, the sides of which with the upper part of the chamber, which is nar-

rowed for this purpose, constitute two passages or flues for the heated air at each side of the bat as it enters and leaves the chamber.

Claim.—“What I claim consists, in the manner in which I effect the drying of the sized bat without the employment of chain aprons or conveyors, such as are generally used therein, viz. by means of the long vertical apartment (for the reception of the bat and hot air) and (in combination with) a passage or flue (for the discharge of the air in a current) proceeding from the upper part thereof; the same being arranged with respect to the size rollers, and the bat being carried through the said passage and into the hot air apartment, and out of the latter through a passage or outlet, and received and wound upon a beam substantially as described.”

10. For improvements in the apparatus for *Working a Vertical Forge Hammer*; George E. Sellers, Cincinnati, Ohio, January 10.

The essential feature of this invention is, for working the hammer by means of two rollers, that receive motion from a steam engine, or other motive force, one of which has its bearings in permanent, and the other in movable boxes connected with a toggle-joint or other lever, so arranged as to force this roller towards the other, and gripe a square rod on the hammer to lift, and then separate them to liberate it—the toggle joint lever being connected with the roller by means of a powerful spring; and the mechanism that operates the toggle so arranged as to enable the attendant to regulate the play of the hammer at his discretion, to strike a light or heavy blow, as the condition of the iron may require.

Claim.—“What I claim as new, is the manner of operating upon the lifting rod by means of the friction drums, one of which is made to advance to, and to recede therefrom, by being placed on a sliding frame which is operated upon by a toggle joint, under an arrangement of parts substantially the same with that herein described. I also claim the manner of arranging the respective levers, the catch, the cam wheels, and their appendages, so as to be operated upon by the lines and chains attached to the said levers, substantially as described.

“And I do hereby declare that I do not intend by these claims, to limit myself to the precise form and disposition of the respective parts of said machine, but to vary these as I may think proper, whilst I attain the same end by equivalent means.”

11. For an improvement in the *Buckle for Connecting Straps*; Kasson Frashure, Manlius, Onondaga county, New York, January 16.

This buckle fastens the straps together without a tongue, and is called by the patentee the “*Angular Box and Grooved roller Buckle.*” The lower plate, which is attached to one of the straps, forms with the upper one an angle, so that at one end they are nearer together than at the other; this constitutes what is termed in the specification the angular box. The upper surface of the lower plate of this box is grooved, and on it runs a grooved roller, the grooves of each fit-

ting into each other like cogs. The strap to be fastened is passed between the top plate of the angular box and this roller, so that the more the strap is pulled, the tighter it is squeezed by the turning of the roller against the upper plate. The angular box is provided with the requisite loops for retaining the straps in their proper directions. The roller is connected with the lower grooved plate of the angular box, by a strap which embraces the middle part of the roller, reduced in size for that purpose, and passes down through a slot in the plate and is there provided with a plate.

Claim.—“What I claim as my invention, is the construction and use for all similar purposes with other buckles, of the following parts of my angular box and grooved roller buckle, to wit, said grooved roller moving upon the grooved surface of the back section of the angular box, and the manner of its attachment to said back section by means of a loop or ring, and a slide, so that the same retains its place and acts upon the strap required to be held by pressing it against the bridge or front section of said angular box, and any and every thing essentially the same: all other parts of said buckle being disclaimed as like, or similar, to those of other buckles now in common use.”

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12. For an improvement in *Buckles, or Apparatus for Connecting Straps*; Charles F. Beverly, Salem, Columbiana county, Ohio, January 16.

This differs from the preceding only in the use of a lever for the roller, so arranged, that, as the part which bears upon the strap, and which is notched for that purpose, is drawn forward by the strap, a catch on the upper surface of the lever is received in a lower tooth of an inclined rack attached to the grooved bottom plate, and thus the lever is caused to gripe the strap the tighter.

Claim.—“What I claim is the method of fastening together the ends of straps and other articles by a combined hinged convex lever and serrated plate, and adjustable sliding bar, whether constructed and arranged in the manner set forth, or other mode substantially the same.”

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13. For an improvement in the *Press for Compressing Cotton, Hay, &c.*; Philos B. Tyler, New Orleans, Louisiana, January 16.

The nature of this invention consists, in applying power to the compression of cotton, or other substances, through the intervention of two sectors, gearing into a double rack, or connected with the piston rod by connecting chains in a manner well known to all mechanics, attached directly to the piston of a steam cylinder, and connected with the platen by the means of two bars or rods, said connecting rods being attached to the sectors at a point within their circumference, which when they revolve by the action of the racks, raise the platen with a power increasing in the proportion, or nearly so, of the increased resistance of the material under pressure.

Claim.—“What I claim is, the arrangement of the sectors and double rack piston rod in combination with the follower of the press, by means of the connecting rods, to adapt the movement of the platen or

follower, to the increased resistance of the cotton, and thus attain the greatest amount of effect, with the least expenditure of power, as described."

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14. For an improvement in *Water Wheels*; James Gardner, South Lee, Berkshire county, Massachusetts, January 16.

Claim.—"What I claim as my invention, is the manner in which I construct my water wheel—that is to say, the form of the buckets having two distinct curves, one of the curves projecting beyond the periphery of the wheel into spiral shutes; the curves on the face and back of the buckets corresponding; and in combination therewith the openings in the bottom of the spiral shutes for the discharge of the water."

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15. For an improvement in the *Endless Floor for Horse Powers*; Luke Hale, Hollis, New Hampshire, January 16.

This is for a method of forming and uniting the chains of an endless floor for a horse power.

The claim is in the following words, viz. "I shall claim the mode of firmly uniting together by one screw bolt the several parts of the three links, B, C, C, and the floor board, viz. by a combination of ears *d, e*, cast upon the inner sides of the two portions of the link B, so as to lap over each other and permit the screw bolt to pass through them and operate upon and with respect to the several parts, as described."

The link, designated in the above claim by the letter B, is composed of two plates of metal, the ends of which are provided with holes to receive and embrace journal or joint pins on the ends of the two links C, C, one at either end, and these two plates are cast with ears *d, e*, that lap on each other so that a bolt passing through a hole in them, and through the end of the floor board, secures the whole together.

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16. For an improvement in *Piano Fortes for producing the harmonic Tones*; Lesley Walker, Carlisle, Cumberland county, Pennsylvania, January 16.

"The nature of my invention consists in producing harmonic tones an octave higher than the original sound of the strings of the piano forte, ad libitum, by means of a set of hammers or weights which are placed in a frame over the strings, and are brought down upon them at the centre of their length by a pedal or other analogous device under the piano, similar to what is used at present to control the soft pedal or damper frame."

Claim.—"What I claim as my invention, is an extra set of hammers, weights or dampers, or a continuous bearing, constructed and arranged as described, passing over the centres of the strings of a piano forte, so as to be brought down upon them by a pedal or other analogous device for the purpose of producing the harmonic tones, as set forth."

17. For an improvement in *Railways*; Wm. M. C. Cushman, Albany, New York, January 16.

This improvement is for capping cast iron base rails with wrought iron in a manner to protect the sides of the base rail, and prevent the rails and caps, at the junctions, from moving out of the proper line.

Claim.—“I am aware that cast iron base rails have been capped with wrought iron rails, and therefore I do not claim this as my invention; but what I do claim as new and desire to secure by letters patent, is connecting the cap rails with the base rails, by means of a fillet, flanch, or rebate, as described, so that by breaking joints the base and cap rails will be retained in their proper lines at the joints, and the cap rails may be extended up to or beyond the inner edge of the base rail, and thus prevent the flanches of the wheels from acting against the base rails.”

18. For a machine for *Pulling Flax*; James H. Bennett, East Bennington, Vermont, January 23.

This machine consists of two or more fingers, (like those of a grain cradle) attached to the end of an appropriate handle, on which there is a slide with one or more fingers fitting between those on the handle, and by means of the slide the flax on the field is griped between the two sets of fingers—the slide on the handle being provided with a lever handle, toggle joint, or other analogous device for operating it.

Claim.—“What I claim as my invention, is the manner of grasping the standing flax for the purpose of pulling it, between the fingers or jaws by means of the movable part sliding and receiving its motion in the direction of the handle from the crank neb, by means of a slot and pin, or toggle joint, as described.”

19. For an improvement in the machine for *Boring and Mortising Hubs, applicable to other purposes*; Reuben D. Roys, and Newell French, Detroit, Michigan, January 23.

Claim.—“We claim the combination in the mandrel of a rotary motion for the purpose of boring and drilling, with a vertical motion, for the purpose of mortising, the mandrel taking both motions in the former operation, and the vertical only in the latter.”

20. For an improvement in the mode of *Casting the Bowl on the stand or pedestal in the process of making Glass Lamps*; P. F. Slave, and John Golding, East Cambridge, Middlesex county, Massachusetts, January 23.

In performing this operation in the old method, the pedestal first moulded is put into the mould and the bowl then put on by blowing; but the improvement in question is for the purpose of avoiding this difficulty by having a platform to receive the pedestal of the lamp, and above it a shaft to receive the upper end of the pedestal, and which at the same time forms the base of the mould for the bowl.

Claim.—“We do not claim as our invention combining the bowl of the lamp with the stem thereof by blowing it on, as that has before

been done, but what we do claim is combining the mould for the bowl of the lamp, constructed substantially as set forth, with the horizontal shelf (into which the top of the foot of the lamp is fitted) and the platform on which said foot rests, by which the connexion or cementing of the bowl and foot is accomplished in a truer and more perfect manner than it can otherwise be done, the whole arrangement being substantially as described."

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21. For improvements in machinery for *Making Wood Screws*; Simeon Brooks, and Wm. N. Clark, Chester, Middlesex county, Connecticut, January 23.

In this case we are under the necessity of omitting the claims, as they refer to and are wholly dependent on the drawings, the publication of which, from their necessary complexity, would carry us beyond the limits of this work; but they are limited to the following arrangements. The first section refers to the machine for paring the head of the screw, and consists of the combination of the lever which carries the cutter or tool with another lever connected with it, and a spring the lower end of which embraces the shank of the screw, back of the head, so that by withdrawing the tool or cutter by the hand of the attendant, the second lever is operated which forces the spring back and discharges the screw blank from the jaws that have been opened previously in a manner well known. The second section refers to the machine for nicking the heads, and is limited to an arrangement of parts for presenting the screws to the action of a circular saw on a mandrel by means of a face plate (having holes near its periphery that receive the screw,) operated by a series of levers to insure the cutting of the nick to the required depth, and then to shift the face plate—the whole being performed by the movement of two levers by the hand of an attendant.

And the third section refers to the threading machine, which cuts the threads by means of two roller dies one of them having its bearings in sliding boxes moved by means of a gauge rod to regulate the cut of the threads. This gauge rod is wedge-formed at that part which operates the slide of the die, and is so connected with the spindle of the jaws that carry the screw, as to force the dies together, as the point of the screw approaches them, to cut conical screws. It is to this arrangement and combination of the gauge, that operates the slide with the spindle of the jaws, that the claim is limited.

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22. For improvements in the apparatus for *Generating, Condensing, and Burning Gas from Oil, Resin or Coal, &c.*; Benj. F. Coston, Washington, D. C., January 31.

Claim.—"1st. I claim the method of introducing the resin or fat into the retort by means of the feeder G, and pipe H, and tube H'; as above described, directly on to the coke or other charge in the retort, whereby the disadvantages arising from the collection of sediment in the ordinary syphon tube are obviated, and the resin or oil is introduced into the hottest part of the retort, without any portion coming in contact with the sides.

2nd. I claim the jacket around the pipe that conveys the gas to the condenser, in combination with the cistern of the gasometer, in the manner and for the purpose described, thus keeping the pipe cool and preventing the tar from baking on to said pipe. 3d. I claim the combination of a condenser constructed and arranged, as made known, with the retort, and gasometer, for the purposes herein specified, to condense the gas that passes through it, and having a cistern below to draw the tar into.

“4th. I claim constructing the gas burner in the manner described, having a long double tube with a conical chamber above it as specified, so as to heat the gas to a high temperature before burning.—Lastly. I claim the mercurial joint, constructed and arranged substantially as set forth, for passing gas from a stationary to a revolving pipe, as described.”

The above claim refers to the drawings, and as they are too numerous to admit of publication within the compass of our notices of patents, we will explain the nature and functions of the parts simply indicated by letters.—Section first. The pipe H, is a pipe extending up from the top of the retort, closed at top, and having another and smaller pipe H' passing through it and extending down about half its length, and extending up into and near to the top of a small cylindrical feeder G, above it, and from near the bottom of this feeder another pipe extends up to the cock of a kettle that contains melted resin or fat. Section second. The pipe J, for conducting the gas from the retort to the condenser, is surrounded by a jacket through which a stream of water passes from the condenser to keep the pipe J, cool. And section last. The mercurial joint of the stationary and revolving pipes is thus formed: The end of the revolving pipe rests on the other by a pivot, and both are pierced with holes, surrounded by a double cup, half of which is attached to each pipe, so that a flanch from the upper one will dip and run in a groove or channel in the under one, made of such depth as to contain a column of mercury, sufficient in height to resist the pressure of the gas, which by this arrangement escapes from the holes in the end of one pipe and passes in to the other—the mercurial cup preventing its escape.

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23. For improvements in the machine for *Reaping Grain*; Cyrus N. McCormick, Rockbridge county, Virginia, January 31.

This is for improvements on that kind of machines in which the grain is cut by the serrated edge of a straight and vibrating cutter, operated by a crank, the grain being sustained by fingers. The blade is serrated like a sickle except that the angle of the teeth is reversed for every alternate tooth, and the supporters of the blade are secured by screws to the front part of the platform, and bent down and then up to give a free escape to straw which may enter the machine.—The fingers for supporting the grain are spear-formed and the angle of the edge begins to run in forward of the edge of the cutting blade, so as to form an angular shear to insure the support of the grain in the act of cutting. The other improvements are fully pointed out in the following claim.

Claim.—“I claim 1st the curved (or angled downward for the purpose described) bearer, for supporting the blade in the manner described.

“I claim the arrangement and construction of the fingers or teeth for supporting the grain so as to form the angular spaces in front of the blade, as, and for the purpose described.

“I claim setting the lower end of the reel post behind the blade, curving it and leaning it forward at the top, thereby favoring the cutting and enabling me to brace it at the top, by the front brace, as described, which I claim in combination with the post.”

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24. For a composition of matter for *Lubricating the Rubbing Surfaces of Machinery*; Increase S. Hill, and Joseph Dixon, the former of Boston, and the latter of Taunton, Massachusetts, January 31.

The patentees say, “Our composition consists mostly of zinc, (which as is well known belongs to the class of cheaper metals) hardened by being compounded with what we denominate a *hardening composition*.

“This latter composition is formed of the following metal, mixed in a state of fusion in the proportions hereinafter specified, viz. fifteen parts of tin to thirty-five parts of copper.

“This composition in a state of fusion is to be mixed with molten zinc and tin, (although tin is not absolutely essential) in the proportion of the *two* parts of the said hardening composition, of *nineteen* parts of zinc, and from three to five parts of tin, according to the peculiar purpose for which the composition is to be used, the tin specified to be added last, having the tendency to render the compound when cold more or less ductile, according to the quantity of the same incorporated therewith. The metal formed without the addition of the last named proportion of tin, when broken, will have the appearance of cast steel of coarse quality, but the addition of tin will make it stronger and cause it to be finer in grain until four parts of the same will be added, when the appearance of the metal on its being broken, will be like that of fine cast steel and more closely resemble the same than any other metal.

“The great strength of the composition combined with a certain degree of softness which it possesses, renders it highly useful in the construction of bearings for rubbing surfaces of machinery, as it is capable of resisting for a great length of time, the effects of wear and attrition. The large proportion of zinc used in forming the compound renders its use in the mechanical arts, much less expensive than the metal ordinarily employed for these purposes, the cost being much less than any other composition in which copper and tin are the principal metals.

“What we claim as our discovery, and desire to have secured to us by letters patent, is the composition or compound metal formed by the admixture of the above specified proportions of *zinc*, and *hardening* composition described, whether tin *be superadded* in the proportions described or not.”

25. For an improvement in the machine for *Drilling, &c., Iron, &c.*; Aretus A. Wilder, Detroit, Michigan, January 31.

The mandrel has a rotary as well as an endwise movement, the latter being communicated by a screw on the mandrel which passes through a nut on a cog wheel. The mandrel also slides through another cog wheel which gives to it the rotary motion by a feather, and this cog wheel takes into another cog wheel on one end of a shaft, parallel with the mandrel and having another cog wheel on the other end taking into the cog wheel on the nut, so that by giving different diameters to these wheels the mandrel with its drill will be moved forward with any desired degree of velocity; but for the purpose of running back the mandrel very fast, the nut has notches in its periphery, into which a dog falls to prevent it from revolving, and at the same time another dog catches on the frame and retains it in place, this is effected by the movement of a lever which at the same time gives an endwise movement to the shaft of the wheel that communicates motion to the nut for the purpose of throwing this out of gear.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the combination of the lever and cogs with the nut and shaft, for stopping the nut and throwing the wheel out of gear, as herein set forth.”

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26. For improvements in the *Plough*; Bancroft Woodcock, Wheeling, Ohio county, Virginia, January 31.

The reversable joint and share of this plough are secured by a wedge for each. The back end of the point passes between the under side of the mould-board and a staple, which extends from the land-side to the mould-board, and then a wedge is driven in between this staple and the under side of the point, and the reversable share has a mortise which passes over a tenon projecting from the under side of the mould-board, and so notched as to receive a key.

Claim.—“What I claim therein as new, is the manner in which I have given stability to the respective parts of my plough, by securing the same together by the means herein set forth: that is to say, by the combined action of the staple and wedges of the projections on the point of the hooked knob, and its wedge, arranged and connected with the other parts as set forth, by which arrangement and connexion of the respective parts, I have those parts which are to bear the main strain and shocks in a form which insures the necessary strength, and prevents them from moving out of their places.

“I do not pretend to claim the use of hooks, mortises, or wedges, but limit my claim as above set forth, to the particular manner in which I have arranged these in my improved plough.”

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27. For an improvement in *Ships' Augers*; Wm. N. Clark, Chester, Middlesex county, Connecticut, January 31.

The upper edge of the single twist auger is made concave, instead

of convex, as heretofore, to give a cutting edge along the entire length of the twist, to assist in clearing the auger.

Claim.—“What I claim as my improvement, and desire to secure by letters patent, is the mode of making the single twist ship auger, the bit and gimlet, with the upper inner surface of the twist *concave*, as above described, and for the object set forth.”

28. For an improvement in the apparatus for *Felting Cloth*; John Andrews, Bellville, Bergen county, New Jersey, January 31.

This improvement is for subjecting the felt to the action of moist and dry heat at the same time. The bed or box on which the bat is felted by the platen or rubber, is hollow and provided with pipes to admit steam to heat it, and this communicates with another steam box, the top of which is pierced with small holes for the escape of steam to that portion of the bat which rests on it before it passes to the rubber to be felted.

Claim.—“What I claim and desire to secure by letters patent, is the manner herein described of combining and arranging the steam box with its perforated top, the second steam box in the rear thereof, and the reciprocating platen and rubber by which it is surmounted, so as to co-operate in the process of felting, in the manner set forth.

“It will be manifest that a single steam box might be made to answer the purpose of the two, but the two are preferred, as being less cumbersome, more easily made, and answering the purpose better than one of double size.”

*Patents Re-issued in the month of January, 1845.*

1. For the *Management and Generation of Heat in the Manufacture of Iron*; C. E. Detmold, of New York, assignee of Von Faber Du Four, of Wertemberg,—granted April 16, 1842, to run fourteen years from the 12th of May, 1841, the date of the first patent granted abroad—January 2, 1845.

The original patent for these improvements belongs to the hiatus in our list which we hope soon to fill up, therefore we shall simply insert the claims under the re-issued patent, for the benefit of those who have made themselves acquainted with this valuable invention.

Claim.—“I claim the collecting and drawing of the combustible gases, chiefly consisting of carbonic oxide gas, from blast and other furnaces, at one or more points below the top of the fuel in said furnaces, substantially as set forth, for the purpose of employing said gases instead of other fuel, for heating all kinds of furnaces used in various processes of manufacturing and working iron or any other metal, and for heating steam boilers or any other structures requiring a high temperature. I claim the above described mode or any other substantially the same, of generating combustible gases from any kind of fuel in separate furnaces or chambers, and conducting the same to other furnaces or structures that are to be heated by the combustion of said gases.

"I claim the mode, or any other substantially the same, of forcing through a system of blow pipes or in any other convenient manner, heated air in numerous small streams and under a pressure greater than that of the atmosphere, into the said combustible gases in the furnaces or structures, where the same are to be used for the purpose of producing by the rapid and intimate mixture of the heated air with the combustible gases, their immediate and complete combustion."

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*List of American Patents which issued in the month of December, 1841, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

(Continued from Page 109.)

23. For improvements in *Propelling Vessels*; Thomas J. Wells, New York city, New York, December 23.

The propellers, two in number, are arranged with their axes in the direction of the length of the boat, and therefore parallel to each other, and are pointed at each end, and in their general form resemble a segar; they are sustained on journals at each end, and are provided with spiral paddles along a portion of their entire length. It is proposed sometimes to make use of these propellers as the only means of giving buoyancy, and at others to add, to assist them in this office, a partial hull or hulls.

Claim.—"What I claim therein as new, and desire to secure by letters patent is the employment of buoyant screw propellers for steamboats, so constructed and arranged as that they shall constitute buoyant portions of the boat, which propellers may in this case be nearly or entirely submerged.

"I also claim the use of such propellers, so arranged and combined with the boat, as that the hull of the boat itself shall dip in the water and concur with the propeller or propellers in giving the whole construction the requisite degree of buoyancy, the said propellers and boat being constructed and arranged substantially in the manner herein set forth. And I do hereby declare that I do not claim the use of buoyant propellers generally, such propellers having been used, or proposed to be used, with their axes crossing the boat, but I limit my claim to the use of buoyant screw propellers, placed like other screw propellers, in the direction of the length of the boat, as herein set forth."

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24. For improvements in the *Syphon for Transferring Liquids*; George Johnson, New York city, New York, December 23.

The first improvement claimed is for charging single or double syphons by means of a bulb connected with the upper part or bend of the syphon, the bulb being of sufficient capacity to contain as much water as will fill the syphon. The second improvement claimed is for shielding syphons against reaction when one leg is to be used in

warm water, by means of a shield or sleeve surrounding the leg of the syphon. And the third improvement claimed, is for the manner of combining the bulb with a double syphon by means of a tube passing from the inner syphon through the neck of the bulb which is of sufficient capacity to form the communication with the outer syphon around this tube.

We are under the necessity of omitting the claims, as they refer to the drawings.

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25. For an *Ignitable Compound for Friction Matches*; Norman T. Winans, Theodore Hyatt, and Thaddeus Hyatt, New York, December 23.

The disclaimer and claim on which this patent is granted, will give the reader a clear notion of the nature of the invention, viz: "What we claim therefore is not glue rendered damp proof by being chemically united with shellace, as this is an old discovery in the arts. Nor do we claim the union of glue and phosphorus either alone or with other inflammables, as these have been known and used for years.— But we do claim phosphorus either alone or in connexion with other inflammables in combination with glue or gum rendered damp proof by being chemically or mechanically united with shellace for the use and purposes set forth."

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26. For an *Inflammable Compound for Friction Matches*; N. T. Winans, Theodore Hyatt, and Thaddeus Hyatt, New York, December 23.

As in the preceding we deem the disclaimer and claim sufficient.

Claim.—"We do hereby declare that we do not mean to limit or confine ourselves to the precise proportion of the respective ingredients used by us, as this may be varied to some extent without changing the nature of our improvement, nor do we claim the using of a solution of shellace or other resin as a part of this compound, when such solution is made by means of alcohol or spirits of turpentine; but we limit our claim to the employment of an aqueous solution of the resin made by the agency of an alkali or the salt of alkali prepared as described, in combination with phosphorus, substantially in the manner and for the purpose made known."

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27. For improvements in the *Cooking Stove*; Eli C. Robinson, Troy, Rensselaer county, New York, December 30.

The claims in this case refer to and are wholly dependent on the drawings, and therefore, we shall omit them, as we do not deem this of sufficient importance to introduce them. The claim is to the method of combining the stove with an elevated oven, whether rotary or sliding, in such a manner as to preserve the communication with the chimney. In the rotary, the elevated oven is connected with the rotary top, and the escape pipe in the elevated oven is placed in the middle and turns in a collar attached to the permanent frame, in which the whole rotates. And in the sliding oven there is a plate

with a short pipe fitting into the permanent chimney, and this plate is provided with flanches that fit in the top of the sliding oven, to admit of its movement without cutting off the smoke passage.

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28. For an improvement in the *Candle Mould*; James Gamble, and Joseph S. Hill, Cincinnati, Ohio, December 30.

This improvement is for surrounding the candle mould with a water chamber, to cool the tallow as soon as it is poured in the mould.

Claim.—“What we claim as new, is the application of cold water to the candle moulds, in any quantity at one operation by inserting the moulds permanently (or not) in a water tight chest, which can be filled and drawn off at pleasure.”

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29. For an improved method of *Cleaning the Rails of Railways of Snow, Ice, Sleet, &c.*; Henry M. Naglee, and Thomas Raney, Philadelphia, Pennsylvania, December 30.

The device covered by this patent is a scraper attached to the front and rear of a locomotive by a joint, and running down to the rail at any inclination, which scraper is made in two parts jointed together, and pressed upon the rail by a spring; when the scraper meets with an obstruction which cannot be moved, the joint yields and passes over it.

Claim.—“What we claim as new, is the arrangement or combination of the iron bar, with joints, and springs, so that the machine will be self-acting, and operate in the manner set forth.”

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30. For an improvement in the *Horse Power*; John A. Toplin, Hammond, St. Lawrence county, New York, December 30.

We have here a method of making large or master cog wheels for portable horse powers in segments. The rim of the wheel is made in parts with tongue and groove joints to insure the accurate fit, when put together, and then a staple is inserted from the outer periphery with one stem passing through a hole in each segment, and passing through to the inner periphery, and there secured by nuts. To give additional stiffness to the connexion, the body of the staple fits in a groove in the outer periphery of the wheel.

Claim.—“I do not claim as my invention, the making of a large cog wheel for a horse power in segments; but what I do claim as my invention is the making of the large or master wheel of a portable horse power in segments when united by clamps, as herein described.”

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31. For an improvement in the machine for *Thrashing and Separating Grain*; Ashley Townsend, Le Roy, Genesee county, New York, December 30.

Back of the thrashing cylinder there is a revolving rake, and below it a concave rack through which the grain passes as the straw is raked off; and below the rack an inclined plane, which conducts the grain, after it has fallen from the concave rack, to a shoe and screen which receive wind from a rotary fan. Beyond the inclined plane just men-

tioned, there is another inclined plane, designated by the letter M, and above this an endless belt of slats, on which the straw is thrown by the revolving rake, for the purpose of carrying off the straw, and discharging the remaining grain on to the inclined plane M, which conducts it to the screen and shoe.

Claim.—“What I claim as new, is combining the raking cylinder, concave rack, and inclined plane, with the shoe, the screen, and fan, as set forth. Also in combination with the foregoing, the inclined plane M, and endless belt or revolving apron of slats, all as set forth.”

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32. For an improvement in the *Inkstand*; George Burnham, Philadelphia, Pennsylvania, December 30.

Claim.—“What I claim as new, in my improved instand, and desire to secure by letters patent, is the employment of a gum elastic bottle or other analogous elastic substance to constitute the body, or reservoir, of the instrument for the reception of the ink, in combination with a tubular shaft passing through said elastic bottle, which shaft is furnished with a cup at its upper end into which the ink from the bottle may be forced at pleasure, by the pressure of said bottle, and from which it may be again withdrawn, by allowing the bottle to expand, the whole apparatus being constructed and operating substantially as described and made known.”

We deem any explanation unnecessary, as the character of this invention is clearly pointed out in the claim; this inkstand is very extensively used.

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33. For an improvement in *Propelling Vessels*; Peter Lear, Boston, Massachusetts, December 30.

In a horizontal semi-circular chamber at the stern of the vessel, there is a paddle attached to a vertical shaft in the axis of the semi-circular case, so that by the vibration of the paddle, the water is alternately acted upon on either side of the shaft.

Claim.—“I shall claim arranging in the counter or other suitable part of a vessel, the semi-circular box having a vertical paddle affixed to a shaft placed in the centre of the curve of the box, (and connected with suitable machinery so as to move alternately back and forth) as described, the whole being arranged and operating substantially as hereinbefore set forth.”

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34. For an improvement in the *Fastener for Window Shutters*; Thomas C. Cary, Poughkeepsie, Dutchess county, New York, December 30.

This is for an improvement in the lever catch attached to the shutter, so as to fasten it when open, as well as when shut. The catch that is inside, when the shutter is closed, opens the other, but cannot be opened by it. The two lie one above the other, in the mortise, and the lower face of the bottom one is notched and the upper face of the upper one, and when introduced into the mortise of the plate attached to the shutter, these notches become the pivots on which they turn.

Claim.—“What I claim as my invention, is the manner of confining the latches to their places, by means of the notches on the shanks thereof, fitting into the upper and lower edges of the mortise in the plate, for the purpose and in the manner specified.”

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35. For improvements in the machine for *Finishing Silk from the Cocoon*; Thomas White, Mount Pleasant, Jefferson county, Ohio, December 30.

Claim.—“What I claim as my invention, is, 1st. Constructing the reel in sections so that each section will wind a single strand, and when filled that the sections can be separated and removed to another axle, for the purpose of spooling, as described. 2nd. The combination of the ratchet wheels, axles, and bent wires, for stopping the motion of the spools placed on said axles, when the silk breaks in doubling it, as described.”

The first section of this claim is sufficiently clear to need no further explanation; and as to the second, it is only necessary to add, that the bent wires have a loop at one end, through which the silk passes, and the other is so formed as to fall into the ratchet teeth on the spools, and stop them when the silk breaks.

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*Specification of a Patent for preventing and removing Incrustation in Steam Boilers, granted to ANTOINE RITTERBANDT, M. D., of Poland, but now residing in Great Britain, Sept. 10, 1845.*

To all whom it may concern: Be it known that I, Louis Antoine Ritterbandt, have invented “improvements in preventing and removing incrustation in steam boilers and steam generators;” and I do hereby declare, that the following is a full and exact description thereof.

The incrustation of steam boilers and steam generators when fresh water is used, arises chiefly from the heat employed to generate steam, causing the lime which exists in the water in the form of a soluble bicarbonate of lime, to be converted into an insoluble carbonate of lime; the particles of which, as they fall towards the bottom, carry down with them masses of other insoluble matters, which may be floating in the water. And when salt or sea water is employed, as in marine boilers, incrustation is generally promoted by the carbonate of lime set free by the heat, which, as it floats in the water previous to subsidence, forms nuclei for the accretion of other matter, and disposes the saline compounds, such as the sulphate of magnesia, chloride of sodium, &c., to crystallize and precipitate much sooner than they otherwise would. Now the nature of my invention consists, in the former case, either in preventing the formation of carbonate of lime, or in converting it when formed into a soluble salt; and in the latter in retarding the formation of the saline crystals, and thereby also retarding the precipitation of other floating matter which would produce incrustation. Thus in both cases the waste of heat and the destruction of the metal ordinarily arising from incrustation, and from the frequent blowing off which is had recourse to, is in a great measure

obviated. The manner in which I effect these objects, I will now proceed to explain.

Although when lime exists in the state of a bicarbonate it is perfectly soluble, but easily converted by heat into an insoluble carbonate, and so precipitated, yet there are other salts of forms of lime which remain in solution as long as the water is not over saturated with them and remains in a heated state. Among these soluble salts are the hydrochlorate or muriate of lime, or, as it is sometimes also called the chloride of calcium, also the acetate of lime and the nitrate of lime. By converting therefore the insoluble carbonate of lime either into a muriate, or acetate, or nitrate, or other soluble salt of lime, it assumes a condition in which it is not precipitated by the heat, and neither incrusts the boiler itself, nor contributes to its incrustation by promoting the crystallization or precipitation of other matters. To effect this conversion, I introduce into the water in the steam boiler or steam generator, or into the supply tank connected with it, some ammoniacal salt, the acid of which uniting with lime as a base, will form a perfectly soluble salt of lime, not decomposed or separated by heat. The ammoniacal salt thus to be employed may be, either the muriate of ammonia (called sometimes the hydrochlorate of ammonia, also chloride of ammonium, and commonly known by the name of sal ammoniac,) or the acetate of ammonia, or the nitrate of ammonia, or any other ammoniacal salt, whose acid forms with lime a soluble compound. I prefer the muriate of ammonia, because of its cheapness, it being easily obtained from various animal and mineral substances existing in great abundance. It is not necessary to employ this salt in a state of purity, the inferior crystals before purification and sublimation serving sufficiently well the purpose of my invention. The quantity of the ammoniacal salt to be employed will depend on the quantity of lime contained in the water in the form of bicarbonate.—This can be readily ascertained by chemical analysis; and I would recommend the following plan for the purpose, as from its simplicity it can be practiced by any working engineer.

Take a gallon, or any other measure of the water to be examined, and evaporate it slowly in an open vessel: Collect the solid matter left at the bottom of the vessel, and weigh it carefully. Then add to it in a glass vessel, a mixture of equal parts of muriatic acid and distilled, or rain water, and let it remain during fifteen minutes. Next, filter through white filtering or blotting paper, or strain through clean linen or calico. Collect the solid matter left in the filter and dry it; the difference between its weight now and before, will give the amount of carbonate of lime dissolved in the muriatic acid. Thus if a gallon of water gives ten grains of solid matter, and after digesting with muriatic acid there are only six grains left, the gallon contains four grains of carbonate of lime. Having thus determined the quantity of lime in a gallon of water, I would recommend the muriate of ammonia to be used in the same quantity, or rather a little in excess, as at the rate of fifty-four of this ammoniacal salt to fifty of the carbonate of lime. If the acetate of ammonia be employed for the purpose of my invention, the preparations must be about forty parts of the saturated

solution, to about fifteen parts of carbonate of lime. What I mean by saturated solution is one prepared by adding carbonate of ammonia to acetic or pyroligenous acid, or to distilled vinegar until no more is dissolved. If nitrate of ammonia be employed, the proportions must be eighty parts of the crystals to fifty parts of carbonate of lime; of course in every case the amount of water evaporated in a given time must be taken into account, as in proportion to the water evaporated will be the carbonate of lime set free and the quantity of the ammonical salt required. The action of the muriate of ammonia (which for the reason before given I prefer) is partly chemical and partly mechanical. First, it is chemical, inasmuch as after the introduction of the salt into the water, a double decomposition takes place. The muriatic acid combines by elective affinity with the lime to form muriate of lime, while the carbonic acid passes to the ammonia and forms carbonate of ammonia. The former, or the muriate of lime, remaining in a state of solution, and the latter, or the carbonate of ammonia, volatilizing under the influence of the heat, and passing off along with the steam. This decomposition, however, goes on slowly and gradually. When the salt is added in considerable quantities at a time, it remains in part in the state of a muriate of ammonia, until fresh supplies of water, containing additional quantities of carbonate of lime to be decomposed, are introduced. In practice therefore it will be found of great advantage so to use the muriate of ammonia, that is, to add it to the water in considerable quantities at a time, since in this way one application may suffice for several days, or even weeks; this however, will depend on the quantity of carbonate of lime in the water and the rate of evaporation. The mechanical action of this salt (as also of the acetate or nitrate or other salts of ammonia, as before stated,) consists in its increasing the density of the water (without however affecting its clearness) and thus assisting to retain in a state of suspension any foreign matter which would otherwise sink to the bottom, and there form a solid incrustation. In case of fixed boilers, the salt is conveniently supplied through the manhole, or injected in a state of solution. In locomotive boilers, the material may be placed in the tank, and must be renewed according to the amount of water evaporated per diem, and the lime present in the water.—When it is required to free steam boilers or steam generators from old incrustation, I use the muriate of ammonia or any of the ammonical salts (whose acids will, with lime as a base, form soluble compounds) in much larger quantities, say double or even treble the proportion described, when the salt is used for preventing only; and when the old incrustation is difficult to remove by these means, and does not readily yield to them, besides the ordinary proportion of ammonical salt before described, I pour once a week into the boiler or supply tank which has been previously filled with water, a quantity of muriatic or nitric acid (but I prefer the former) in the proportion of one pint to one hundred gallons of water;\* renewing the

\* Or if the acetic acid be used, in the proportion of one quart to one hundred gallons of water; or if common vinegar be employed, in the proportion of one gallon to one hundred gallons of water.

operation once a week, until the incrustation is removed. When these ingredients are introduced into the boiler, it is advisable that the engine should be off work.

And having now described the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim, is, first, the application of ammoniacal salts in the manner before described, to prevent and remove incrustation in steam boilers and steam generators. And secondly, the use of ammonical salts in *conjunction* with muriatic, acetic, or nitric acid, for the purpose of removing old incrustation, in the manner above described.

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## MECHANICS, PHYSICS, AND CHEMISTRY.

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*On the different varieties of Sugar, and allied substances, with reference to the practical application of their Optical relations.*  
By VENTZKE.

Translated from Erdman's *Journal der Pract. Chemie*, vol. xxv, p. 65, by J. C. Booth, and M. H. Boyé, and communicated to the *Journal of the Franklin Institute*, by Prof. R. S. McCulloh.

I. *On the Circular Polarization of aqueous solutions of Sugar.*—This beautiful discovery of Biot, is equally interesting to the chemist and the technologist. The following contains a description of the apparatus employed for this purpose, and the method of using it.

*Description of the Apparatus.*—In all the figures similar letters indicate similar parts.

A. fig. 1, plate 1, is a firm stand, to which is attached by the hinge C, a board B, B, 18 inches long, 2 inches wide, and  $\frac{1}{2}$  an inch thick; so that it may be fixed at any angle with the horizon. On this board is fixed, 1. a wooden support K, with a circular perforation, and a round disk D, fastened to it by screws; in the middle of which a Nichols' prism is fixed, as shown in E'. These prisms are made by grinding the natural rhombohedron (Figs. 4, and 5) of Iceland spar, whose surfaces of cleavage, *g, e*, and *f, h*, form an angle of over  $70^\circ$ , in such a way that they have  $68^\circ$ : after which the rhombohedron is cut through perpendicularly to the main section of the crystal, and at right angles to the new terminal plane, as shown by *e, k, f*, fig. 5, (natural size) being the side view, and fig. 4, the front view. These oblique sections are first finely polished, and then again glued together with Canada balsam, by which the desired object is obtained, almost to annihilate the second image and divert it so much that by proper screening it cannot be seen. It is preferable to grind the four long side faces dull, and cover them with black paint, to prevent reflection.

This prism E', is fastened to an index *a*, figs. 6, 7, so that both may be turned round their axis right or left, while the disk D, remains fixed. The latter is furnished with a graduation, the zero of which is vertically above  $+180^\circ$ .

2. A support F, on which a second Nichols' prism is fastened in a

case in such a way that it may be moved round its axis, and fixed accurately at any point.

3. Two shorter supports, G, G, with rests *d, d*, which may be lowered or raised for the reception of the tube H, lined on the inside with black velvet.

4. A stand G', which supports a small argand lamp I, of the usual construction, with a wick  $\frac{1}{2}$  inch in diameter. In the tube H, strong glass tubes (K, figs. 2 and 3,) of about 7 to 8 Mm. in width are placed, which have an exact length of 234 Mm. This is taken as the *normal length* in all experiments. The tubes are closed above and below by glass plates *b*, the brass caps C', C'', being screwed on, which are furnished with corks that press on the glass plates.

Fig. 6 shows the front view, and fig. 7 the side view of the graduated disk D.

*Mode of Using the Apparatus.*—1. *Fixing the Zero.*—When a ray of light passes through a Nichols' prism, and is observed through a second one, similar to it, two points will be observed by turning one of them on its axis, in which the polarized light disappears totally. If the first point be called zero, the other lies  $180^\circ$  distant from it, or is diametrically opposite to it. For our purpose it is sufficient to determine one of them.

The foremost prism E', is for this purpose fixed, by means of its index *a*, by the aid of a magnifier, exactly on zero of the circle (fig. 6,) and then the prism E'', is turned until a transmitted ray of light disappears perfectly. This operation can only be performed with accuracy by the direct rays of the sun. For as the slightest deviation from the plane of polarization, in which all light disappears, immediately causes a small portion of it to pass through; this is so obvious by the intense light of the sun that the really dark point is confined within the smallest limits, and its determination becomes as accurate as possible. By the use of any other source of light, the determination of this point becomes so uncertain that all experiments, solely from this one cause, lose all accuracy. The prism E'', is then fixed immovably by the screw.

As the determination of the zero is only done on special occasions, and afterwards only for control, every possible care should be bestowed on it.

2. *Arrangement of Solutions.*—These are always to be prepared as colorless and clear as possible, and too much care cannot be bestowed on this point. For although slightly colored solutions may still be examined with some degree of certainty, turbid ones prevent any determination. In most cases coarsely powdered animal charcoal, previously freed from all soluble salt, is sufficient for decolorization. Long glass cylinders of different width, may be employed, furnished at the bottom with a small hole which may easily be filled up by filtering paper. These are filled  $\frac{3}{4}$  with the animal charcoal, and the solution passed through by displacement, keeping the upper part filled during the whole time.

The specific gravity is then ascertained with accuracy at least within a thousandth part. For this purpose I employ, as the tubes only

hold 9 to 12 cub. cent. small hydrometers 130 Mm. long, which have the convenience of allowing small quantities to be experimented with. After the lower glass plate has been fixed firmly by the screws at C'', fig. 3, the tube is filled so that the top surface of the liquid shows a convex surface at *m*, after which the upper glass plate is put on so as to leave no air in the tube. The cap C', with the cork, is then screwed on, and the outside of the plate cleaned as well as possible. The tube is placed in the hollow cylinder H, fig. 1, and supported on the rests *d, d*, in such a way that the cap C' reaches into the central perforation of the support K, so as to lay close to the prism E'. The rests *d, d*, are adjusted so as to make the axes of the prisms and the tube coincide. The prolongation of this axis must strike the most luminous part of the flame of the lamp I, which may likewise be lowered or raised on the upright G'.

3. *Mode of Observing.*—As above mentioned the instrument is fixed at zero. If then the flame of the lamp be viewed through the prism E', darkness will be observed, if the colorless liquid produce no circular polarization, as is the case with pure water. If the contrary be the case, the flame is seen clear and with its own color.

The foremost prism, E', is then turned to the right. If colors appear in the following order, light blue, dark blue, violet, purple, red, and orange, *then the polarization is to the right*; if the above order of colors appear on turning E', to the left, the polarization *is to the left*. As soon as the red appears, which lies between purple and orange, the degrees from zero are read off as indicated by the index.

In order to determine this important point accurately by comparison, a closed tube has been fixed at M, fig. 6, which is likewise directed towards the flame. This tube is filled with a liquid which invariably by the influence of light and heat, shows exactly the same tone of red color, which is here desired. It was not an easy matter to obtain such a liquid, until Marchand found that an aqueous solution of anilate of iron answers perfectly for this purpose. It only requires a little practice to bring the desired color to correspond to the permanent color of the solution. I shall afterwards return to the particulars of this operation, when on the technical use of the apparatus.

*Reasons for the Adopted Construction of the Apparatus.*—It is not required, with the acknowledged advantages of the Nichols' prism, to give the reasons why this prism was employed for polarization instead of the mirror in the apparatus described by Boit. By almost getting rid of the one image and attaining a greater light, the observations may be performed more easily and with greater certainty, more especially, it becomes possible to determine the zero with very great accuracy, on account of the greater light. The zero once fixed by the direct rays of the sun, it requires no change of the difference, if the tube be placed as done by Biot, free between the prisms, and not as has been tried by securing two prisms immediately on the tubes. By the latter arrangement it becomes necessary to take apart the whole apparatus for every filling of the tube; and the zero must then be fixed by marks on the apparatus. But that this is less accurate,

may be judged of by the fact, that a difference in the adjustment of no more than one-tenth of a degree, produces a difference of nearly one per cent. in the determination of cane sugar in mixtures with molasses sugar; and this is the most frequent use of the apparatus for technical purposes, whereas the tenth part of a degree in so small a circle as that of the encasement of a prism, does not amount to more than one hundredth of a line. The simplicity in the construction where the prisms are screwed on, is more than counter-balanced by the steadiness and firmness in experimenting, whenever a number of different sugars are to be compared, and for greater certainty the experiments are to be tried several times and in quick succession. The apparently more complicated apparatus deserves, on account of its easier management, the preference.

If the sky of France according to Biot, causes great difficulties on account of the varying light, how much more must this be the case in northern latitudes! It was difficult to arrive at certain results before this difficulty had been overcome by using a good uniformly burning lamp. While clouds acted differently, from white objects on the surface of the earth, the uniform grey sky differently, from the bluish white of clear days; the effect seemed again different from places nearer the horizon, than from places of the sky which already reflected it more than usually polarised. At any rate the brilliancy of the tints differed under the above different circumstances, and this materially affects the observations. Such dependence on the time of the day, and the state of the atmosphere would be inconvenient, and in many cases, injurious.

Biot considered it easy to determine the deviation by observing the red color which follows after the purple. As we employ a solution which always shows the desired color, so that the observation does not depend on the practice and memory of the observer, the apparatus is rendered more certain and easier for many persons to use.

As the effected deviation thus becomes determinable by direct comparison, the employment of one colored light by the use of red glass is less preferable, especially as it always yields a smaller deviation, and therefore an error of observation, expressed in per centage must always be greater than by the method I employ, even independent of a greater uncertainty in the observation.

Glass tubes are preferable to metallic ones on account of the greater facility in cleaning them. The solubility of the metal is also an inconvenience, nor can reflection be altogether avoided. By proper screening, the latter may be made entirely inactive, and even without this precaution, by a proper position of the lamp it has no disturbing influence, since it returns the same colors of the centre. The use of glass plates for closing the ends has always been found useful with substances which are so easily decomposed as the sugars.

*Experiments.*—In the following table the sugars proper, that is, such as are capable of the vinous fermentation, either directly or indirectly, are arranged in such a manner that those which polarize most to the left are placed first, and those which produce the greatest

deviation to the right, are placed last. Then follow other substances which have some relation to the sugars and their combinations.

	Aqueous Solutions of	Degrees of Polarization.		Specific gravity at 17°C. (63½ F.)	Percent. of dissolved substance
		To the left.	To the right.		
1	Fruit sugar from grapes, . . . .	35½	—	1,1056	—
2	“ “ “ honey, . . . .	36	—	1,1056	—
3	“ “ “ the action of acids on cane sugar, . . . .	35½	—	1,1056	—
4	“ “ by fermentation from cane sugar, . . . .	36	—	1,1056	—
5	Molasses sugar, . . . .	0	0	1,105	—
6	Milk sugar, . . . .	—	43	1,102	25
7	Grape sugar, every variety, . . . .	—	46	1,095	25
8	Saccharate of chloride of sodium, . . . .	—	41	1,117	25
9	Cane sugar, . . . .	—	56	1,1056	25
10	Dextrin sugar, . . . .	—	92	1,1056	—
11	Dextrin, . . . .	—	19	1,011	3,36
12	“ by calculation, . . . .	—	140	—	25
13	Mannite, . . . .	Produce no Circular Polarization.			
14	Glycyrrhizin, . . . .				
15	Glycerin, . . . .				
16	Gelatin sugar, . . . .				
17	Gum arabic, . . . .				
18	“ “ obtained by fermentation, . . . .				
19	Amylon in water, . . . .				
20	“ dissolved by potassa, . . . .				
21	Caramel, . . . .				
22	Potassa-saccharic acid, . . . .				
23	Potassa-saccharate of lime, . . . .				
24	Glucinic acid, . . . .				
25	Glucinate of lime, . . . .				
26	Apoglucinic acid, . . . .				
27	Apoglucinate of lime, . . . .				
28	Alcohol, . . . .				
29	Acetic acid, . . . .				
30	Chloride of sodium, . . . .				

*Remarks on the above Experiments.*

Nos. 1 to 4. **FRUIT SUGARS.**—This name has been given to a variety of sugar which under all circumstances is *uncrystallizable* and always polarizes to the left. It occurs,

1st. In a great number of sweet fruits. In this case it was prepared from perfectly ripe grapes, in which it always occurs with grape sugar. In proportion as the above sugar prevails, the grapes are sweeter, but yield less grape sugar, which agrees with experience.—

2nd. In honey, it is contained in abundance in that portion which remains liquid. It may be produced,

3rd. By the action of acids on other varieties of sugar, which are hereby not solely converted into grape sugar, but yield a mixture of both; as for instance even by the action of sulphuric acid on cane sugar in vacuo, at a temperature of from  $65^{\circ}$  to  $75^{\circ}$  C. ( $149^{\circ}$  to  $167^{\circ}$  F.) whereby only a small portion of ulmic acid is formed, (Mulder) which can easily be separated. The quantity of grape sugar is often so small that its separation by crystallization requires a long time, since the presence of fruit sugar highly impedes it. The presence of grape sugar may in such cases be easily overlooked, but observe: Whenever sugars which polarize in opposite directions, occur together in such proportions that they produce no change of colors to either side, the polarizing power of the solution is still manifested by the suspension of the zero of the instrument: for it exhibits at this point, light instead of darkness. The light, which in this case when the instrument stands at zero, passes through both prisms and the solution, may still be polarized. Passed through a Nichols' prism it exhibits the phenomena of ordinary but not of circular polarization.

4th. By the influence of ferment on cane sugar and probably also on milk sugar.

Before its metamorphosis into alcohol and carbonic acid, cane sugar is converted not into grape sugar as supposed by Rose, but into fruit sugar. As soon as the fermentation is fairly under way, the solution polarizes to the left, and continues so in decreasing proportion till the sugar is entirely destroyed. By choosing the right point the fruit sugar may thus be obtained freed from an admixture of any other variety of sugar, and its perfect purification is less difficult than where it occurs together with grape sugar. These difficulties are also the cause why the results of No. 1 to 3 differ somewhat from 4.

Should it even be probable that the 4 above varieties of fruit sugar should be identical, this is yet to be proved by analysis and by their chemical combination.

No. 5. MOLASSES SUGAR.—It is often considered a variety of cane sugar, and as such, called uncrystallizable cane sugar, sometimes it is called mucilaginous sugar, and Berzelius calls it Caramel. It is doubtful whether any one has yet fixed the true characters of this variety of sugar, in its pure state, for the different accounts of its properties disagree considerably. It is sometimes confounded with fruit sugar.

Biot and Andere prescribe for the separation of this sugar from cane sugar, wherever they occur together, to extract the mixture with alcohol. All my own experiments to arrive by this method to a certain result, failed. Molasses from cane sugar dried as far as possible, yielded to absolute alcohol even by a temperature of  $50^{\circ}$  C. ( $122^{\circ}$  F.) hardly any traces of it, and with decided admixtures of cane sugar.

By the use of alcohol of specific gravity 0.812 to 0.840, and still weaker, it gave mixtures in various proportions.

The preparation of a pure molasses sugar being of the utmost importance, in order to try the application of circular polarization in practice, the effect of boiling in converting solutions of cane sugar into mo-

lasses sugar was tried. Molasses from which sugar boilers could obtain no crystals of cane sugar, and which when of a spec. grav. of 1.1056, polarized  $24^\circ$  to the right, was kept boiling with free access of air, and renewal of the evaporating water. With the same density it polarized

After  $5\frac{1}{2}$  hours boil  $21^\circ$  to the right.

"	$11\frac{1}{2}$	"	"	$10\frac{1}{2}^\circ$	"	"
"	18	"	"	$4\frac{1}{2}^\circ$	"	"
"	25	"	"	$0^\circ$	"	"

The point of ebullition was kept constant at  $105-106^\circ\text{C.}$  ( $221^\circ-222.8^\circ\text{F.}$ ) Kept boiling for 10 hours more it still exhibited no sign of polarization.

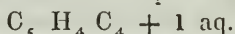
It seems impossible to discover by any chemical test when the conversion into molasses sugar is finished. This can only be done by circular polarization. The test with oxide of copper shows with mixtures of molasses sugar and cane sugar, in which the former amounts to 60 per cent. or more, no indication of cane sugar, for even by perfect decolorization the liquid above the precipitate of hydrated protoxide of copper shows no blue color.

Cotemporaneously with the molasses sugar, other coloring matters are formed which deserve a closer investigation. These substances are perhaps identical with those, which, according to Mulder, are formed by the action of acids on cane sugar, and which have been examined as shown in the table. Peligot's caramel is only formed by the action of heat on the sugar, where it has become dry. Its existence amongst the products of boiling is therefore incidental and may be easily avoided.

Biot observes, that as the uncrystallizable cane sugar has a smaller power of circular polarization than the crystallizable, it requires a larger quantity in order to produce the same degree of deviation when it forms a certain proportion of the mass. From this remark, it is evident that Biot did not by extraction with alcohol obtain pure molasses sugar, for the latter shows no circular polarization whatever. It is perfectly indifferent by the use of the rays of the sun, or of the flame of a lamp, or by white clouds.

Molasses sugar is likewise formed by a peculiar variety of viscous fermentation.

No. 6. SUGAR OF MILK.—Its composition being,



which latter escapes by heat, as water of crystallization; 25 parts of crystallized milk sugar, and 75 parts of water contain then,

Milk sugar	$(\text{C}_5 \text{H}_4 \text{O}_4)$	22 per cent.
Water,	-	(H O) $\frac{78}{100}$

Cane sugar containing basic water, but no water of crystallization, its comparison with milk sugar minus 1 aq. must stand as follows:

Solution of cane sugar cont. 22 per cent. indicates	$49^\circ$
" Milk Sugar minus 1 aq.	$43^\circ$
Milk sugar less than cane sugar,	$\frac{6^\circ}{}$

but solutions of 25 per cent. crystallized milk sugar compared with solutions of the same per centage of cane sugar yield : 56 — 43 = 13° less for milk sugar.

No. 7 and 8. GRAPE SUGAR comprises:

1. Diabetic Sugar.
2. Solid sugar of honey.
3. Sugar formed by the action of diastase or acids on amylon and similar substances.
4. Sugar produced by the action of many acids on cane sugar.
5. That variety of sugar which is contained in many sweet fruits, which in its pure state and freed from the uncrystallizable variety of sugar which accompanies it, (vide No. 1–3) exhibits the same peculiar form in the grouping of crystals and the same circular polarization.

Grape sugar is capable of direct fermentation, as shown by H. Rose. The whole mass does not first pass into fruit sugar, for by examination of the fermenting liquid it polarizes all the time to the right in proportion to its content, and yields at any time grape sugar in crystals. In these experiments sugar from starch was employed, obtained by the action of sulphuric acid on potato starch. Its fermentation was very vigorous.

Grape sugar loses 2 at. of water by cautious heating beyond its point of fusion. It thereby assumes the appearance of dextrin sugar, but dissolved in water its power of polarization is exactly the same as before the expulsion of its water of crystallization at the same density of the solution, and it yields likewise by crystallization unaltered grape sugar. This water being therefore only water of crystallization a solution of 25 parts of grape sugar in 75 parts of water of 1.095 specific gravity, contains

$$\begin{array}{rcl} \text{C}_{12} \text{H}_{12} \text{O}_{12} & = & 22.75 \text{ per cent.} \\ \text{H O} & = & \underline{77.25} \text{ " " } \\ & & 100. \end{array}$$

A solution of this strength polarizes 46.00° to the right.  
 “ cane sugar of 22.75 per cent polarizes 50.70° “ “  
 Cane sugar more than grape sugar, 4.70°

Compared with a solution of cane sugar of 25 per cent., a 25 per cent. solution of grape sugar ( $\text{C}_{12} \text{H}_{14} \text{O}_{14}$ ) polarizes 10° less to the right.

Grape sugar minus 2 at. of water of crystallization indicates therefore very nearly the same deviation as cane sugar.

No. 8. Exhibits the circular polarization of the compound of grape sugar with chloride of sodium. According to Erdman and Lehman, the formula for this compound dried at 130° C. (266° F.) is, in 100,

$$\begin{array}{rcl} \text{C}_{24} \text{H}_{24} \text{O}_{24} & = & 82.46 \\ \text{Na Cl} & = & 13.42 \\ 2 \text{ aq.} & = & 4.12 \end{array}$$

25 parts dissolved in 75 parts of water contain therefore in 100 parts

$$\begin{array}{rcl} 20.62 & \text{C}_{12} \text{H}_{12} \text{O}_{12} & \\ 3.35 & \text{Na Cl} & \\ 76.03 & \text{Water} & \end{array} \left. \vphantom{\begin{array}{r} 20.62 \\ 3.35 \\ 76.03 \end{array}} \right\} = 79.38 \text{ non-polarizing substances.}$$

But 20.62 per cent. of grape sugar freed from its water of crystallization and dissolved in 79.38 water, yields likewise  $41^\circ$  deviation as shown in the table. The polarization agrees therefore exactly with its chemical analysis and renders it so much the more probable that the grape sugar enters unchanged into this remarkable combination.

In some cases of diabetes when urine contains sugar, so as to be capable of fermentation, it sometimes polarizes to the left, so that it must contain either a substance which polarizes to the left, or what is not improbable actual fruit sugar.

Biot assumes that uncrystallizable grape sugar, as he calls it, passes by crystallization into a sugar analogous to starch sugar, which then, under any circumstances, polarizes to the right. But this seems to be a deception. It has been already mentioned that fruit sugar (which is Biot's uncrystallizable grape sugar,) impedes in a high degree the crystallization of grape sugar, which often accompanies it. The mixture therefore remains liquid for a long time, but at last crystallization takes place, especially at a low temperature and the proper degree of concentration. The grouping of the minute crystals of grape sugar then often renders the mass so porous that it absorbs the fruit sugar and becomes solid. One part of fruit sugar with 9 parts grape sugar, give a solid and apparently a dry mixture, in which the fruit sugar may be easily overlooked.

No. 9. CANE SUGAR.—The density with 25 per cent. of pure sugar corresponds exactly with Niemann's table, which is very correct.—In future the specific gravity of 1.1056 will be called the normal density whenever the question is to determine the per centage of crystallizable sugar in sugar of cane.

No. 10. DEXTRIN SUGAR.—When *amylon* is converted into grape sugar either by dextrin or by acids, a sugar is formed which remains uncrystallizable under all circumstances, and appears to be as it were a medium substance between both. Commercial starch-molasses, as it is called, when properly prepared and freed from coloring matters, consists mostly of this variety of sugar which may be called dextrin sugar. Its crystallization which the manufacturers are so much afraid of, only occurs when it is mixed with too much grape sugar.

Biot mentions that he has found several varieties of sugar obtained by the action of sulphuric acid and oxalic acid on *amylon*, to exhibit a stronger polarization. "It would be important, says he, to investigate whether these varieties of starch sugar with very strong polarization power be not mixtures or combinations of dextrin with starch sugar." This investigation seemed much facilitated since the discovery of Trommer, that dextrin mixed with a solution of sulphate of copper, yields by the addition of a dilute solution of caustic potassa in excess a solution of an azure blue color which does not change. Grape sugar yields, it is true, a similar solution, but only for a few moments. The solution soon becomes turbid and changes into green, then yellow, and deposits hydrated protoxide of copper. Fruit sugar, molasses sugar, mannite, and milk sugar, exhibit the same reaction. Cane sugar yields a similar blue solution as dextrin. As starch is not converted into cane sugar, it was to be hoped that by this beauti-

ful test (the copper test) the presence of dextrin might be discovered in starch molasses. A solution of 3 parts of starch sugar and 2 of dextrin was tested in this way, but after some time it only exhibited in the cold the test of pure starch sugar. By heating to about 40° C. (104° F.) it took place at once; the supernatant fluid was never of a blue color, nor was this the case with starch molasses alone. Fermentation was then tried when it was found that after the destruction of the sugar, a considerable quantity of dextrin remained, which by repeated treatment with alcohol could be obtained as pure as that obtained by nitric acid and amylon.

Alcohol in sufficient quantity, extracts dextrin sugar and grape sugar which always occurs in commercial starch molasses. After separation of the latter, the dextrin sugar remains, being completely destructible by fermentation. It shows in this case the strong polarization to the right, indicated in the table.

Solutions of grape sugar and dextrin sugar (containing say 40 per cent. of the latter) crystallize soon in cold, which proves that the crystallization of grape sugar in starch molasses must be prevented by something else, which is the dextrin sugar acting here as fruit sugar, and in combination with the dextrin prevents the crystallization for a long time.

No. 11 and 12. DEXTRIN.—The very great deviation caused by this substance, amounts by calculation for a solution of 25 per cent., to over 140° to the right.

No. 13. MANNITE. Both that from manna, and from celery (*apium graveolens*) behave as stated.

No. 14. GLYCYRRHIZIN.—Its deep color allows only the employment of a very dilute solution.

No. 15. GLYCERIN prepared from linseed oil.

No. 16. GELATIN SUGAR free from leucin, as described by Mulder.

No. 17. GUM.—According to its behaviour it was the genuine gum arabic.

No. 18. Solutions of cane sugar of 1.050 spec. grav. pass by the action of a peculiar ferment at the ordinary temperature of the air under certain circumstances, very rapidly into a kind of viscous fermentation, so that the whole mass may be drawn into long threads. No generation of gaseous products is observed. The cane sugar soon disappears while a gum-like mucus, molasses sugar and a small quantity of an acid (perhaps lactic acid) are the products; afterwards very different decompositions take place. This mucus yields by the copper test, a blue solution like dextrin, but differs from it both in its want of polarizing power, and in other points.

No. 19 and 20. AMYLON either dissolved in boiling water and filtered, or in cold water by the addition of some caustic potassa.

No. 21. CARAMEL prepared according to Péligré. Its dark color allows the employment of only very dilute solutions.

No. 22 and 23. POTASSA—saccharic acid and its lime salt prepared according to Péligré.

Nos. 24 to 27. GLUCINIC and APOGLUCINIC acids and their *combi-*

*nations with lime* (sacchulmic acid and sacchulmine) obtained by the action of sulphuric acid on cane sugar according to Mulder.

The sugars proper, considered without regard to their chemical behaviour may be found to agree in the following properties: 1. They are without color. 2. They possess a sweet taste differing in intensity. Their solutions of the same specific gravity would form a series as follows: Cane sugar, sugar of fruits, molasses sugar, dextrin sugar, milk sugar, grape sugar, being the least sweet. 3. They are fermentable: Fruit, molasses, grape, and dextrin sugar directly, milk and cane sugar indirectly.

It may also be remarked that all sugars proper may by any reaction, be converted at last into grape sugar, but that the latter is incapable of being converted into any other variety of sugar.

To be Continued.

*On some Remarkable Properties of Water and other Fluids, and their Connexion with Steam Boiler Explosions.* By JOHN ED-  
DOWES BOWMAN, ESQ.

(Continued from page 188.)

The lecturer proceeded to draw from his enquiry, something of a practical, and therefore perhaps more interesting character, with reference especially to the subject of steam-boiler explosions; a subject on many accounts of so much importance, that no words of his were needed to enlist attention for a short time to it.

Until within the last few days, he had supposed that no one had attempted, previously to M. Boutigny, to account for the explosion of boilers on the supposition that the water in them passes, under certain circumstances, into the spheroidal state. In this, however, he found that he was partially mistaken, and felt great pleasure in saying, that one of his townsmen, Mr. Robert Armstrong, some few years ago, advanced an idea on this subject, a good deal similar to that of M. Boutigny. If heat be applied to water contained in an open boiler, the temperature of the water will of course continue to rise until it reaches  $212^{\circ}$ , when the elastic force of the steam is sufficiently great to overcome the pressure of the atmosphere, and the water boils. If the heat be still continued, the whole of the water will boil away, leaving the vessel empty; but as long as any liquid remains, the temperature of the vessel never rises above  $212^{\circ}$ , owing to the absorption of heat by the steam. As soon as the boiler, however, is empty, its temperature of course rapidly rises, and may reach a red, or even white heat, provided the furnace be sufficiently powerful. If water be now gradually thrown into the over-heated boiler, we know from what has already been said, that it will pass at once into the spheroidal state, and will continue at  $205^{\circ}$ , until, from some cause or other, it is permitted to *come in contact* with the heated surface, when violent ebullition immediately takes place, an enormous quantity of steam is instantaneously produced, and if the vessel be a closed one; as is the case with steam-boilers, an explosion is the almost inevitable result. An experiment exceedingly easy of performance, is sufficient to

illustrate this. Let a large spheroid be formed in a vessel of platinum or copper; so long as the heat is applied to the latter the water never shows the least sign of boiling; but if the lamp be extinguished, and the vessel allowed to cool a little, the water suddenly comes in contact with the metal, an enormous quantity of steam is instantly formed. A spheroid composed of between four and five pints of water has been, in this way, experimented with, when the sudden formation of highly elastic steam was very striking. If water be boiled for some time in a copper flask, or small boiler, until the whole of the air is expelled, and the vessel be then tightly corked, and the source of heat removed, it is well known that as the water cools and the vapor condenses, a partial vacuum is formed; and, owing to the external pressure of the atmosphere, the cork is held firmly in its place, and offers considerable resistance to any attempt to withdraw it. Far different, however, is the effect produced, if, instead of boiling the water in a comparatively *cool* flask, it be thrown into one which is sufficiently hot to cause it to pass into the spheroidal state. So long as the flask continues hot, nothing remarkable occurs; but if the lamp be removed and the temperature of the metal be allowed to fall lower than  $350^{\circ}$  or  $400^{\circ}$ , a faint noise is shortly heard, and the moment after, a violent explosion takes place, projecting the cork or stopper from the mouth with considerable force.

Now, all this is easily explained. The water, on ceasing to be spheroidal, *wets*, or comes in contact with the heated boiler, and is converted instantaneously into steam, which, being thus generated in vast quantity, finds an outlet at the point of least resistance. This experiment proves that if water exists in the spheroidal state in a boiler, and the boiler be allowed to cool, owing to the extinction of the fire, an *explosion* is the almost certain consequence. A result precisely similar is produced by adding a quantity of cold water to a boiler containing a portion of liquid in the spheroidal form. But here the question arises, Does water really ever become spheroidal in steam boilers? and if it does, what are the circumstances which lead to so dangerous a crisis? That water contained in boilers does pass into the spheroidal state, there can be no doubt, since we know that sometimes circumstances are such that it could not possibly be otherwise, and moreover, it has actually been seen to be so. What then are the causes which lead to this occurrence? The most obvious cause is a deficiency of water in the boiler; owing either to the negligence of the engine man, or to some defect or derangement of the feed-pipe. When this deficiency occurs, the boiler, if the furnace underneath be in action, shortly becomes highly heated, and it is by no means an uncommon occurrence for it to reach even a red heat. If water, under these circumstances, be thrown in, the first portion becomes, of course, spheroidal, and continues so, until, by the addition of a larger quantity, the boiler be so far cooled, as to be unable to maintain the spheroidal form of the water; no sooner is this the case than the spheroid comes into contact suddenly with the overheated boiler, bursts into steam, and in all probability, an explosion is the result. Another and highly probable cause of water becoming spheroidal is suggested

by Mr. Armstrong, in his excellent work on Steam-engine Boilers, and which is well worthy of notice. After alluding to the subject of boiler incrustations, and the effect they have in preventing the passage of heat from the furnace to the water, owing to their non-conducting property, he says:—

“Under similar circumstances to those mentioned, there can be no doubt that a part of the boiler occasionally becomes nearly red-hot, although this condition appears extremely inconsistent with the supposition, that it is at the same time covered with water; yet we have been compelled to adopt this conclusion, from having had ocular demonstration of its possibility, as well as other reasons. We had frequently heard the fact stated by intelligent engine men, and had been called, more than once, to witness it, although even then inclined to consider it a mistake, owing to the difficulty of ascertaining it clearly; for a slight approach to the incandescent state must be nearly invisible, owing to the strong glare of light from the furnace directly beneath, while any degree of heat much higher, would be sure to weaken the iron so much as to cause the boiler-bottom to give way. The probability of boilers sometimes approaching a red heat, receives a corroborative proof on examination of the iron plates, in cases when the boilers have bulged out, and which exhibit an appearance well-known to boiler-makers by a peculiar color in the iron surrounding the part which has been red-hot.

“Whenever,” he continues, “a boiler is seen in this state, of course the only method of avoiding danger is to slack the fire immediately by opening the fire doors. But it frequently happens that the fireman thinks that the boiler is empty, and if he has an opportunity, he immediately lets into it a quantity of water, when the *consequence uniformly is, that the boiler bursts instantly.*”

The bursting in this case we can now readily understand. It is precisely similar to our last experiment, in which the spheroidal state of the water was destroyed by the addition of a quantity of cold water.

Mr. Armstrong goes on to say,—“From what we have stated above as the common practice in some districts, we may conclude that the principal cause of boilers becoming unduly heated, is undoubtedly, in a majority of cases, owing to the interposition of indurated or encrusted matter between the heated *iron and the water*, and the manner in which those circumstances operate in producing an explosion, appears to be as follows:—

We have before shown that an internal coating of boiler scale is liable to break and separate into large pieces, which are thrown off from the boiler with a certain degree of violence, at some particular degree of temperature, depending upon the thickness of the scale, and the kind of substance of which it is formed.” He then proceeds to explain how, by the sudden separation of those pieces of encrusted earthy matter, the water flows upon the overheated metal, when, of course, the result will be, that a portion of the water becomes spheroidal, which, on subsequently coming in contact with the hot surface, is immediately converted into steam. Seeing then, the imminent danger which always attends the presence of the spheroidal water in a

boiler, it becomes a question of the highest importance, whether any means can be devised, which will effectually prevent such an occurrence.

If it were possible to ensure a constant, uniform, and never-failing supply of water to the boiler on the one hand, and to prevent the accumulation of earthy sediment or crust, on the other, there would be little or no fear of the water ever becoming spheroidal. But there are great and serious obstacles in the way of these conditions being practically complied with; both on account of the liability to derangement which affects most kinds of feeding apparatus, and the great difficulty which exists, both in preventing and removing the depositions of the earthy matters which are found more or less abundantly in most kinds of natural water.\*

It has been found that the more smooth and even the surface of a metal is, the more prone is water or any other liquid, on being thrown upon it, to pass into the spheroidal state; and that any great roughness, or especially the presence of sharp points considerably lessens the danger of such a change. There is, however, a great objection to fixing projecting points in a steam-engine boiler, on account of the difficulty they would occasion in cleaning it out; and the idea occurred to M. Boutigny of placing in the boiler, loose pointed pieces of iron, of such a shape, that one of the points should always be uppermost.

Before concluding, he would say one word respecting the possibility of preventing an explosion, even when the water *has* become spheroidal in a steam boiler.

And here an experiment, which we have already seen, will suggest the best mode of proceeding, in order to avert the impending danger. When water was thrown into a hot platinum crucible, and thus made to assume the spheroidal form, we found that so long as the crucible continued hot, the globule floated on its bed of vapour, slowly and gradually evaporating, and showing no appearance even of boiling, still less of passing explosively into steam; but no sooner did we allow the crucible to cool down to a certain temperature, than the water, on touching its still overheated sides, was instantly dissipated in the form of highly elastic steam.

If then, it be ascertained by the engine man, that the water in a boiler has become spheroidal, his chief care should be to keep up the fire, and also to prevent most completely the influx and further supply of water; since non-compliance with either of these conditions, would cause the cooling of the boiler when the spheroid would, in all probability, shortly be converted suddenly into steam, and an explosion would be the almost inevitable consequence. But if, on the other hand, that spheroid be *not* allowed to touch the boiler, it will calmly and slowly evaporate, without occasioning any further inconvenience than rendering the engine comparatively inactive, until it has returned to the natural condition.

\* As most kinds of spring and river water contain, in solution, some earthy matters which are left by the evaporation of the water, giving rise to the formation of sediments and incrustations, it had often occurred to the lecturer, that rain-water might be substituted with great advantage.

The advice then, relative to this subject, which should be given to those who have the charge of engines is simply this :—

*1st.* Be careful that the boiler is kept as free as possible from earthy incrustations, which, if allowed to accumulate, form, in fact, a boiler of stone inside the iron one, and thus retard the passage of heat from the fire to the water, until the iron has become more or less overheated.

*2ndly.* Never let there be a deficiency of water in the boiler, since, when that happens, the latter may become heated almost indefinitely, and is consequently sure to render the water spheroidal, when thrown in ; when an explosion will be (without great care) almost certain.

And, lastly, if it be known that, owing to any cause, the water in a boiler has already become spheroidal, instantly stop the supply of water, and take care that the fire is well kept up, until the whole of the water is evaporated ; when that is the case, the boiler should be allowed to cool to its natural temperature, when water may be added, and the fire rekindled.

[At the conclusion of the lecture, an extremely interesting discussion took place, in which the chairman and several other scientific men took part, in the course of which, the case of the late explosion of a locomotive engine on the Manchester and Leeds railway was considered ; but all agreed that its origin could not be attributed to the formation of spheroids in the boiler, as it had at the time of the explosion, abundance of water in it, neither was it at all encrusted by any earthy matter. All the circumstances of the case being considered, it would appear that the only tenable supposition which could be entertained as to its origin, is that of simple over pressure. The steam having burst the top of the inside fire-box, and come in contact with the ground beneath, the re-action thereby occasioned, was considered sufficient to raise the engine to the height mentioned, namely, thirty feet.

Nevertheless we could enumerate many instances of explosion, which might with perfect justice be attributed to the formation of spheroids on the water getting low in the boiler ; perhaps we may cite the case of the Telegraph steamer, which exploded at the Helensburgh quay, in March, 1842, as being the most likely one of any we can at present remember. An account of this explosion will be found in our first volume, at page 274. The engine, in this instance, had made one stroke, and was in the act of making a second, when, for a moment, a hissing noise was heard ; this was followed almost immediately by a terrific explosion.

The supposition in this case would be, that the water in the boiler having become low during the standing of the engine, it had assumed the spheroidal form, and immediately upon the starting of the engine, the influx of water from the pumps (if in action at the time,) would reduce the heat of the boiler so far, as to render it unable to maintain the spheroidal form of the water. No sooner was this the case, than the spheroids would suddenly come in contact with the heated metal, and explosion would immediately ensue.

This subject, however, is one which certainly merits further inves-

tigation, and we are persuaded that a more strict inquiry into it, would throw a good deal of light upon various serious explosions, which, until now, it was impossible to account for.]

Glasgow Prac. Mec. and Eng. Mag.

### *Stephenson's Railway Wheel.*

This is one of those practically good improvements, which we should like to see more generally imitated by the engineering profession, as it combines extraordinary cheapness with great durability and elegance of appearance. It is the production of Messrs. R. Stephenson & Co., at their locomotive factory, where several thousands of the wheels have been manufactured within the last two or three years, being, in fact, the staple wheel of that celebrated firm.

Fig 8. Plate 1, is an elevation of a four feet locomotive wheel, with tyre complete, made on this principle.

Fig. 9, is a section through the centre of the wheel.

Fig. 10, is a view of one of the pieces of rolled T iron, bent into the shape required for the spokes.

A, Fig. 10, is a cross-section through one of the spokes, and

Figs. 11 and 12, are side and front views of the cast-iron block used for bending the spokes to their shape.

The peculiarity of the improvement consists in forming the spokes of the wheel of rolled T iron, of the section shown at A, Fig 10.

In making the spokes, the length required for each is first accurately measured off, and centred longitudinally, the projecting fin is then slightly bevelled off at each extremity as shown at *a*, Fig. 10; a hole is now punched through it at the same part, and it is then ready for bending.

For this purpose the block (Figs. 11 and 12) is used, it is grooved down the centre for the purpose of receiving the projecting fin of the bar. The length of iron before mentioned is now made hot and bent round the block, the central notch being applied to the central point of the block, so that the bends are made exactly in the centre, the block is slightly bevelled inwards at the point on each side, so as to give the ends of the spokes a better hold in the boss, and is in two halves, divided down the central groove, for the purpose of allowing the detachment of the spokes when bent; the two halves are held together whilst in operation by a powerful screw passing through the centre of each half.

Each spoke, or rather each pair of half spokes (for it will be seen by reference to A, that each spoke is formed out of two bent pieces) is now laid on a plate, and the boss cast on in the usual manner, the holes in the ends of the spokes being of material use in giving them a firm hold in the boss. The tyre is now shrunk on in the usual manner and the vacant spaces at the parting of the spokes where they meet the inner side of the tyre, are filled up with baked oak timber which is secured by driving into it two small iron wedges. — These pieces of wood are found to answer as excellent preventives of

vibration in the wheel; and being wedged up in a very dry state, they are afterwards swelled by the moisture of the atmosphere, so that no joint whatever is seen, the whole having the appearance of solid metal.

It will be seen that the projecting fin on the spoke-iron is not in the centre of the metal; this is to allow of the insertion on the wider side of a  $\frac{3}{4}$  inch bolt, for securing the rim portion of the spokes of the wheel to the tyre; a bolt is placed in the centre between each spoke, and being on the inner side, as shown in the section, they are not at all seen from the outside. If the size of the wheels is more than 5 ft. or 5 ft. 6 inches, a single rivet is put in each spoke to connect the two halves more firmly, but in small wheels this is not at all required, the contraction of the tyre produces so close a contact between them that the joint is scarcely perceptible. The general practice has been to put an equal number of spokes in these wheels, as in the example here given; we think however, that a decided improvement might be effected, by using an odd number, so that no two opposite spokes would be in one diameter allowing thereby a certain degree of elasticity in the wheel, which, we think, would be favorable for both the wheels and the rails. It has been found in practice that these wheels are most durable when the spokes are not wider apart than 12 inches measured on the rim, also the smaller the radius of curvature of the spokes at the parting the better; in the present instance, it is about two inches.

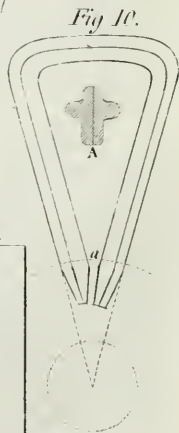
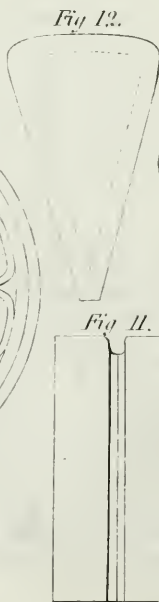
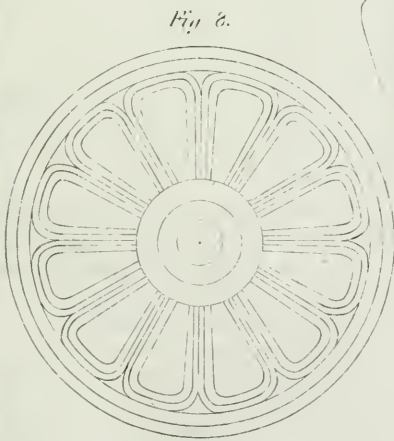
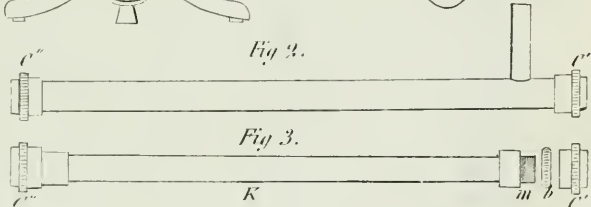
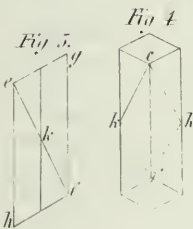
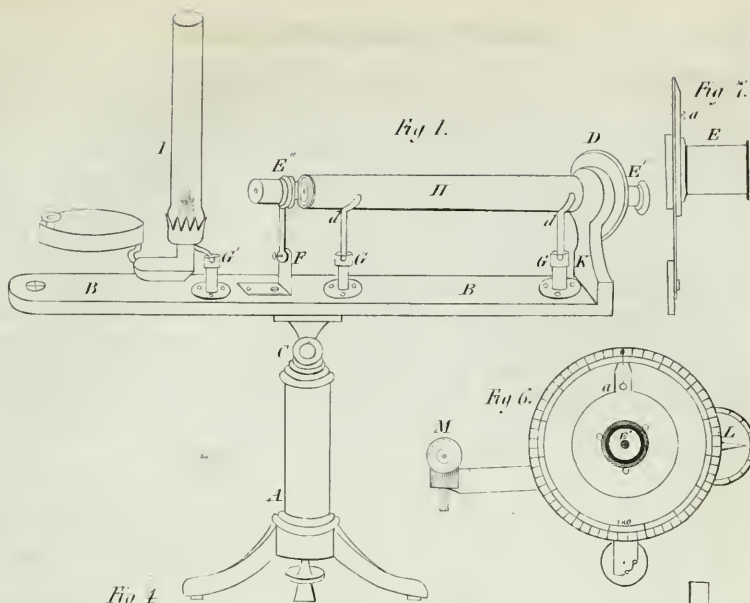
No small argument in favor of these wheels is their elegant general appearance, due to the shape of the spoke. With regard to their durability, we understand that of several thousands, which have been running for some time upon various lines of railway, not one has failed through any fault in the construction. Their very great cheapness, likewise, compared with wheels made in the usual manner with round or flat spokes, is another point in their favor: being, we should suppose, as far as workmanship is concerned, not more than one-sixth.

*Ibid.*

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### *The Scotch Pig-Iron Trade.*

The manufacture of pig-iron in Scotland is steadily on the increase. In the *Mining Journal* of the 7th inst. we gave a tabular statement of the number of furnaces in existence and in operation, from which it will be seen that, up to the end of May, the total number of furnaces in Scotland was ninety-one, of which seventy-five were in and sixteen out of blast. We now find, from the following table, that up to the end of June there are ninety-one built, twelve building, and ninety in blast, being an enormous increase in so short a time, and fully proves that there exist capabilities for increasing the make of iron in proportion to the demand, to an extent which some of our contemporaries have deemed impossible. We have seen it asserted, that "not another furnace could be blown in within twelve months;" yet here we have an additional number at work, capable of producing several hundred tons of pig-iron per week. That an enormous and





continually-increasing demand for iron, for all the great engineering works proposed, must take place there is no doubt, but we do think that it will be found that there is capital and enterprise among the iron masters equal to the emergency; it is the system of speculating on the demand, buying for the account, and not the demand itself, which has caused so much of the unpleasant consequences which have, of late years, at intervals marked the iron trade; were all transactions *bonâ fide* sales, and would the smaller makers abandon the often ruinous practice of taking large orders, which it is not in their power to execute, the iron trade would be as steady as any branch of commercial business—paying a good per centage for the capital invested, and supporting a very large amount of the working population in comfort. The following is a statement of the blast furnaces, and weekly produce of pig-iron in Scotland, in June, 1845:

	Building.	Built.	In Blast.	Weekly Produce.
Gartsherrie,	—	16	15	1700
Dundyvan,	—	9	9	1000
Monkland,	2	7	7	850
Calder,	—	8	6	660
Govan,	—	5	5	650
Langloan,	1	5	5	650
Carnbroe,	—	6	5	560
Clyde,	—	6	5	540
Coltness,	1	5	5	600
Summerlee,	—	5	4	420
Glengarnock,	1	4	4	520
Shotts,	1	3	3	300
Muirkirk,	1	3	3	250
Carron,	—	3	3	240
Devon,	—	3	2	160
Blair,	4	3	3	330
Castlehill,	—	2	2	200
Omoa,	1	3	2	180
Garscube,	—	2	1	100
Bonaw,	—	1	1	50
	12	99	90	9960

The stocks of pig-iron in Glasgow have, in fact, increased to an enormous amount, causing many to believe that the supply has outstripped the demand, but which, we believe, to be only the effect of the ironmasters speculating for a rise, and when such a situation of things becomes general, however the price might for a time be bolstered up, the “crash” must come at last. To attain permanent prosperity in so extensive a branch of industry as the iron trade, the supply should go to a certain extent hand in hand with the demand; and now that German, French, and American capitalists are successfully improving their make, and competing with us, it is time that English and Scotch iron manufacturers should take measures to secure those markets, which, by careless, and even reckless speculation, may be lost to them for ever.

Mining Journal.

*Jeffery's Marine Glue.*

The government of France having had their attention immediately directed to the importance of the patent marine glue, which, from its great strength and preservative qualities, has given such universal satisfaction, a commission was appointed by the Minister, in November, 1843, to make a series of experiments at the port of Toulon, directed to the making top-masts in separate pieces, the preservation of timber under water, and bottoms of ships, the caulking of vessels, putting together blocks of stone and cementing masonry, and also its application to the preservation of iron plates and chains, having specially in view the bottoms of iron vessels, and to report thereon; only those relating to caulking ships, and the preservation of timber under water, and iron plates, are yet sufficiently matured, and on these they have made a report. The marine glue was applied to the caulking of the poops of the steamer *Le Titan*, the ship *L'Ocean*, and the frigates *L'Iphigenie* and *La Proserpine*. *Le Titan* remained exposed to the sun during the whole summer of 1844, without ever being wetted, and when the winter rains set in, not a drop of water passed through the seams; the glue still adhered, notwithstanding all the movements they had gone through from the action of the heat and humidity; with the former the seams opened, and the glue remained in them; in the latter they closed, and the glue was forced out, forming a hard beading, which it was very difficult to remove. The *Ocean* was on the Tunis station, and experienced very bad weather, she, however, returned to port in December, and her caulking remained perfectly sound. The *Iphigenie* was payed on the 2d and 6th of August, without oakum in the seams; she was at sea in very bad weather, and although her planks worked exceedingly, the caulking with the marine glue still remains entire. These instances prove that the glue perfectly resists the motions of the vessel, and adheres to the planks, even when they gape, in consequence of the laboring of the vessel. It is found superior in regard to its durability, since it is still completely unaltered on board the vessels where it had been used eight months ago, whilst the caulking with pitch required to be done over at the end of the same period. The marine glue has another important advantage over pitch, which is, that it will not melt except at a much higher temperature. It often happens in hot climates that the pitch becomes so soft as to melt through the seams, and sticks to the feet; this is an inconvenience which has not occurred with marine glue. From these experiments, the commission has agreed on the following decision:—"That the marine glue caulking is superior to common caulking for rendering the seams impervious; and its greater expense at first, in comparison with the latter, is fully compensated by its superiority and greater durability. The commission, therefore, considers that it will be for the advantage of the state, to substitute marine glue for pitch and oakum." They then proceed to experiments for the purpose of trying the effects of the marine glue as a preservative from marine insects, weeds, and shell-fish. A four-sided box was made, each side con-

taining five planks; some of these planks were coated with the glue, mixed with 2 per cent. of a poisonous mixture of bi-chloride of mercury dissolved in ligneous spirit; some only had a horizontal stripe laid on them, and some were left without the poisonous preparation; the box was immersed in a part of the wet dock at Toulon, remarkable for the vigorous attacks of marine insects, and the abundance of marine vegetation, on the 10th June, 1844, and first examined on the 9th September, when the parts unprepared showed the usual ravages of the insects, and were covered with shells and seaweed; the prepared planks showed no signs of punctures, but those parts not poisoned were covered with weeds and shells. From the foregoing experiments, it results that the poisoned marine glue preserves the wood from the punctures of marine insects; and that the corrosive sublimate dissolved in ligneous spirit and applied over the marine glue, protects, at least for a certain time, the surfaces under water from the seaweeds and shells, and that the experiments made on a boat and on the bottom of the schooner *La Topaze*, confirm the foregoing results.

Mining Jour.

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*Extracts from the Transactions of the Fifteenth Meeting of the British Association for the Promotion of Science.*

ON A NEW PROPERTY OF GASES, by *Prof. Graham*.—After explaining the law which regulated the diffusion of gases through porous bodies, and stating the fact, that the lighter gases diffused themselves much more speedily than the more dense ones,—that their diffusion was equal to the square of their densities,—he proceeded to relate his experiments on the passage of gases into a vacuum. To this passage the term Effusion has been applied. The velocity of air being 1; the velocity of oxygen was found to be .9500 by experiment, and by calculation .9487. Carbonic acid, being much heavier than air, gave the number .812. Carburetted hydrogen gave .1322 as the velocity of its effusion. Hydrogen gave as the velocity of effusion 3.613 by experiment, which was very nearly the amount given by theory. The interference of friction, even of minute orifices, was then described, and shown to admit of easy correction. Some useful applications were mentioned; as in the manufacture of coal gas, where it is desirable to ascertain the quality, as well as the quantity of gas manufactured. As the gas will pass the orifice on its way to a vacuum the quicker the lighter it is, and the more slowly as it increases in density, and as the superior carburetted hydrogen is heaviest, it would be easy to construct an instrument to register this velocity, and thus mark at once the required quality and quantity of gas. It was also proposed that an instrument might be used in mines to detect the presence of light carburetted hydrogen (fire damp.) The passage of gases under pressure through porous bodies was termed by Prof. Graham, Transpiration. The mode adopted in experiment, was, to take a glass receiver, open at the top, which was closed with a plate of stucco. This

was placed on an air pump, the air exhausted by the pump, and the velocity with which the air passed through the stucco being marked by the mercurial gauge of the pump. The transpiration of atmospheric air was found to be greater than that of oxygen. Carbonic acid is found to be more transpirable than oxygen—or even, under low pressure, than atmospheric air. The transpiration of hydrogen is one-third more rapid than that of oxygen. The applicability of this process of experimenting to the explanation of exosmose and endosmose action in the passage of fluids through porous bodies was pointed out.

Mr. Bain made some observations to the effect, that Prof. Graham's researches went to explain many meteorological phenomena, but particularly the suspension in the atmosphere of masses of aqueous vapor, in the form of clouds.

ON RECENT EXPERIMENTS ON THE GAS VOLTAIC BATTERY, by *Prof. Grove*.—No previous description of the Gas Battery having been given before the Association, Prof. Grove entered into an explanation of the action of hydrogen gas upon spongy platina, and gave a description of the first gas battery constructed with platina wire sealed into glass tubes in pairs,—hydrogen being put into one tube, and oxygen into the other. An arrangement of this kind being connected with a voltameter, it was found that exactly the same quantity of gases was eliminated in the tubes of that instrument as combined in the tubes of the battery. Experiments have been made with a view of ascertaining if other gases might be used in the battery, and it was discovered that a great variety of gases might be so used. Prof. Grove then pointed out how perfectly any endiometric analyses might be carried on with the gas battery, provided some attention were paid to a few sources of error. A form of the instrument as hitherto constructed by Prof. Grove was described, for the purpose of avoiding the absorption of atmospheric air by the fluid in the cells of the battery. A more recent construction of the battery was next described, in which many of the imperfections in the former instruments were removed, and a combination of several pairs of gas tubes are connected in one compact body. Another advantage arising from this battery is the really constant condition of it; once charged, it appears that the action will go on for years, requiring nothing more than occasionally, at long intervals, adding a little zinc to the acidulated solution in the cells, for the purpose of supplying the loss of hydrogen in the tubes. The results of long experiment have shown that the most invariable action may be counted on for years; and that, by this instrument, experiments requiring for a long period the constant flow of a galvanic current may be most effectually carried out. Some experiments on the combination of phosphorus and sulphur with oxygen in the battery were then named; and it was found, that any body capable of volatilization gave a galvanic action with oxygen in the other tube. Camphor, alcohol, ether, and other bodies proved the constancy of this effect. It was then stated, that in all cases it had been found that chemical action and voltaic action were convertible into each other.

ON THE ACTION OF GASES ON THE PRISMATIC SPECTRUM, by *Dr. Miller*.—Referring, in the first instance, to the experiments of Sir D. Brewster on the changes produced on the fixed lines of the prismatic spectrum by various absorptive media, Dr. Miller proceeded to explain his method of examining the subject. The light, being passed through a longitudinal slit in a plate of metal, was received on a prism of Munich glass; the spectrum thus formed was passed through the gaseous medium under examination, and the resulting effect observed by a telescope. It was found that the dark lines of the spectrum materially changed their positions as different colorless gases were used; and that, by subjecting the spectrum to the absorptive influences of chlorine, nitrous acid vapor, the vapors of iodine, bromine, &c., numerous dark, and some luminous bands, not previously observed, were brought into view. The spectra produced by colored flames was also examined, and many curious conditions observed. Dr. Miller had sought to ascertain if any relation could be found between the chemical characters of the bodies under examination and their properties of exhibiting Fraunhofer's lines; but as yet no such relation could be detected.

RECENT EXPERIMENTS ON OZONE, by *Prof. Schönbein*.—Professor Schönbein was first induced to undertake his researches from the obscurity which rested upon the phenomena of the odor produced during the galvanic decomposition of water, resembling the smell of an electrical machine, and during thunder storms. In pursuing these researches, the author was led to the discovery, that the smell was always developed at the positive pole; that it was capable of being preserved in closed bottles; that heat destroyed it, and that many of the metals had also the same power. Experiments were made with a view to discover some means of procuring ozone easily; and after the trial of a great many bodies, it was found that phosphorus was particularly suited for the purpose. If a piece of phosphorus is placed in a bottle of common air, when maintained in a moist state, it readily produces this peculiar principle, on which the electrical smell depends. Several experiments were shown, to illustrate the effects of ozone in bleaching litmus paper and paper colored with indigo, or a solution of that substance. If powdered iron or silver are placed in vessels containing ozone, the smell is immediately removed, and the metals exhibit a kind of oxidation. Other bodies were named, as producing a similar result; and many chemical decompositions were found to arise from exposure to the action of this peculiar principle. Solution of iodide of potassium is rapidly decomposed, iodine being set free; this was shown by a mixture of this salt with starch, which, on being exposed to the action of ozone, turned blue by the formation of iodide of starch. Bromide of potassium was also decomposed by this principle, and bromine liberated. Salts of iron were shown to undergo the same changes. A number of organic bodies, both vegetable and animal, destroy the ozonous smell. If ozonized air be made to pass through a tube, and this tube gently heated, all the properties of ozone

are destroyed. This was shown by experiment. By the inspiration of ozone, similar effects are produced on the lungs to those resulting from chlorine and bromine. A mouse was killed in five minutes, and the experimentalist himself was seriously affected by breathing an atmosphere charged with this odor. By electrolysis, gold or platina points are necessary for the development of ozone. The electrical brush in all cases produces the same effects as those above described; all the decompositions can be produced, and the same smell is distinctly evident. In this case, as in the other, heat and some of the metals also destroy the odor. Endeavors have been made to procure ozone in an isolated state, but they have not been successful. Ozone, although at first supposed to be an elementary body, was afterwards considered as a compound of oxygen and hydrogen. The fact of heat destroying this peculiar odor at once, shows that this principle is produced from the elimination of an oxygen compound from the decomposition of water. This is quite in accordance with the views entertained by Mariniac, who has pursued the investigation with great industry, and who has published a memoir, in which his views are luminously set forth. The author of this report is of opinion that ozone will turn out to be a compound isomeric with the binoxide of water. A theoretical view of the production of this body was then entered into. The ordinary action of phosphorus undergoing oxidation in the atmospheric air was explained, and the remarkable fact stated that although phosphorus was luminous in moist air, it was not so in perfectly dry air. Ozone may now, therefore, although long regarded by Prof. Schönbein as an elementary body, be looked upon as, in all probability, a tritoxide of hydrogen. Its bleaching properties are very remarkable, and it may possibly be of considerable practical utility.

EXPERIMENTS ON THE SPHEROIDAL STATE OF BODIES, and its Application to Steam Boilers, and on the Freezing of Water in Red-hot Vessels, by Prof. Boutigny.—Prof. Boutigny, who made his communication in the French language, first proceeded to show that a drop of water projected upon a red-hot plate does not touch it; but that a repulsive action is exerted between the plate and the fluid, which keeps the latter in a state of rapid vibration. At a white heat, this repulsion acts with the greatest energy, whilst it ceases, and the ordinary process of evaporation takes place at a brown-red heat. The temperature of the water whilst in the spheroidal state is found to be only  $96^{\circ}$ , and this temperature is maintained so long as the heat of the plate is kept up. To bring this water to the boiling point, ( $212^{\circ}$ ) it is therefore necessary to cool the plate. These phenomena are explained by M. Boutigny on the supposition that the sphere of water has a perfect reflecting surface, and consequently that the heat of the incandescent plate is reflected back upon it; and some experiments have been made which show that this is the case, the plate becoming visibly redder over those parts on which the vibrating globule played. Several experiments were made in proof of this necessary cooling to produce ebullition. The red-hot plate, with its spheroidal drop, was

removed from the spirit-lamp, and after a minute or two, the water began to boil, and was rapidly dissipated in steam. Ammonia and ether were shown, although so exceedingly volatile, to act in the same manner; the ether, however, being decomposed whilst in the vibratory condition, in the same manner as it is by the action of platina wire, forming a peculiar acid. Iodine put upon the heated plate became fluid, and revolved in the same manner as other fluids, no vapors escaping whilst the high temperature of the metal was maintained; but when allowed to cool to the point of dull redness, it was immediately dissipated in violet vapors. The nitrate of ammonia fused on the glowing hot plate, and vibrated with great energy; but on cooling the capsule, the salt entered into vivid combustion. The repulsive action was shown by plunging a lump of silver at a glowing red heat into a glass of water. As long as its bright redness was maintained, there was no ebullition; but as it slowly cooled, boiling took place. In this experiment, it appeared as if the glowing metal formed around itself an atmosphere; and the contiguous surfaces of the water appeared like a silvered plate. The application of the principles involved in these phenomena to the tempering of metals was then explained. If a metal to be tempered is in a highly incandescent state, the necessary hardening will not take place on plunging it into water. It is, therefore, necessary that a certain temperature should be observed. Experiments were made to show that the repulsive power of the spheroidal fluid existed, nor merely between it and the hot plate, but between it and other fluids. Ether and water thus repelled each other, and water rested on and rolled over turpentine. The bursting of steam-boilers came next under consideration; and it was shown that many serious explosions may be referred to the phenomena under consideration. In a great many cases, the explosions have occurred during the cooling of the boilers after the withdrawal of the fire. An experiment was shown in proof of the view entertained by M. Boutigny. A sphere of copper, fitted with a safety-valve, was heated, and a little water being put into it, it was securely corked up, and withdrawn from the lamp. As long as the metal remained red, everything was quiet; but upon cooling, the cork was blown out with explosive violence. The concluding experiment excited great interest. The production of ice in a vessel at a glowing red heat was a result so anomalous, that every one was desirous of witnessing the phenomenon for himself. It was beautifully performed by M. Boutigny, in the following manner:—A deep platina capsule was brought to a glowing red heat, and at the same moment, liquid sulphureous acid, which had been preserved in the liquid state by a freezing mixture, and some water, were poured into the vessel. The rapid evaporation of the volatile sulphureous acid, which enters into ebullition at the freezing point, produced such an intense degree of cold, that a large lump of ice was immediately formed, and being thrown out of the red-hot vessel, handed round to the company in the Section.

Mr. G. Rennie referred to some experiments of his own, in confirmation of M. Boutigny's views.

ON FIZEAU'S PROCESS OF ETCHING DAGUERRETYPE PLATES, and its Application to Objects of Natural History, by Mr. Goadby.—In a Daguerreotype portrait, the black parts of the plate consist of silver, the white of mercury, and the intermediate tint of a mixture of the two, the degree of darkness or light depending upon the excess either of the silver or of the mercury. In converting a Daguerreotype into an engraved plate, it is necessary to etch away the dark parts and to leave the white untouched. This is done by immersing the plate in a fluid, consisting of dilute nitric acid, nitrous acid, chloride of sodium, and nitrate of potash. The nitric acid is so far diluted, that no decomposition can take place until the mixture is heated, when the chloride of sodium and nitrate of potash are decomposed, and chlorine and nitrous acid are evolved. These attack and remove the silver, or the *dark* portions of the plate, but have no effect on the mercury, so that the *lights* of the picture, being the mercurialized portions of the plate, constitute the *etching* ground, and effectually defend such portions of the Daguerreotype from the influence of the corroding fluid. After a time, those portions of the plate that have been acted upon by the chlorine, &c., become covered with a protecting coat of the chloride of silver: this must be removed by dilute liquid ammonia, when the biting may be continued by a fresh supply of the mixed acid. Grease and foreign matter must be removed by repeated washings in dilute acid and alkali, and by boiling in caustic potash. These cleansing operations must be repeated after every biting, after washing out the chloride of silver by the ammonia. The plate being thus bitten, but in a slight degree, is to be inked after the ordinary manner of engravers, and allowed to dry; the surface of the plate is then to be thoroughly polished, the ink still remaining in the corroded portions of the plate. It is now to be gilded by the electrotype, those parts alone receiving the gold that have been previously polished. The ink is then to be dissolved out of the hollows by potash: the parts that are gilded now constitute the etching ground, instead of the mercury, and the biting may be henceforth continued by nitric acid, in the customary usage of engravers. The plate thus etched, generally requires to be finished by the hand of the engraver, who has the advantage of a *perfect*, although *faint* picture to work upon. The amount of labor which he must bestow will depend upon the goodness of the Daguerreotype, and the success of the etching. M. Claudet has fully established the successful application of this process to the purpose of illustrating Natural History, by copying from Nature and engraving several delicate and difficult dissections of the lower animals, particularly the nervous system of *Aplysia* and *Tritonia* (the latter much magnified,) and the nutrimental organs *in situ* of a caterpillar. These preparations, together with the engravings of them, were handed round.

Dr. Carpenter stated, that a similar process had been employed for engraving microscopic objects, the discovery of which was due to Capt. Ibbetson. He exhibited some plates of blood globules, and other microscopic objects published by Dr. Donné, of Paris, which had been procured in this way.

ON A NEW METHOD OF CONVERTING RECTILINEAR INTO ROTARY MOTION, by *Dr. Booth*.—The object of the communication was to show the applicability of a new species of crank, termed by the inventor the *sliding crank*, to the steam engine, more especially in those cases where space is an object of primary consideration. One of the most important improvements effected by this motion is, that the distance between the shaft and the top of the cylinder is only one-half the length of the stroke. Other advantages pointed out in the course of the paper were, that the friction on the sliding parts is nearly insensible; that almost all the parts of the engine have a rotary instead of a reciprocating motion; that all the subsidiary parts of a low-pressure engine are worked with great simplicity; and that in this construction, a longer stroke than in any other of the same dimensions may be introduced, and the expansive principle more fully developed.

Mr. J. Taylor made a few remarks, and observed that the effect of friction on the action of slides, seemed to be in general much overrated.—Mr. Fairbairn observed, that the invention, if carried into successful operation, seemed adapted to work an improvement in marine engines, especially, where room was a matter of great importance, by lowering the position of the machinery, which appeared a great desideratum at the present day. He objected, however, to the difficulty of obtaining free access to some parts of the machinery; the raising of the piston cover, for example, on this construction, would be a laborious operation.

NASMYTH'S STEAM HAMMER FOR PILE DRIVING.—This machine has been described at former meetings of the Association. Dr. Greene now read a letter received from Mr. Nasmyth, dated Devonport, in which it was stated that at the first trial with a part of the machine at the manufactory it drove a pile 14 inches square, and 18 feet in length, 15 feet into the ground with 20 blows of the monkey, the machine then working 70 strokes a minute; the ground was a coarse ground imbedded in a strong tenacious clay, performing this work in 17 seconds. The entire machine is now in full action at Devonport for the embankment to be erected there to keep out the sea, and form a wet dock. He describes it as going far beyond what he had dared even to hope for, and that it is truly laughable to see it stick vast 66 feet piles into the ground as a lady would stick pins into her pin-cushion. The entire of the operations required to be performed on each pile from the time it is floated alongside of the stage until it is embedded in the solid foundation of slate rock is only  $4\frac{1}{2}$  minutes. The great stage which carries the machine, boiler, workmen, and every thing necessary, trots along on its railway like a wheelbarrow and moves on, the diameter of a pile, the moment it has finished the last. It picks the pile up out of the water, hoists it high in the air, drops it into its exact place, then covers it with the great magic cap, which follows it as it sinks into the ground, then thump goes the monkey on its head, jumping away 70 jumps a minute. At the first stroke the

pile sank 6 feet, its advance gradually diminishing until in the hard ground above the solid slate rock it was reduced to 9 inches. Nothing can better prove the superiority of the principle of this invention, of getting the momentum by a heavy weight moving with small velocity over the same momentum, as got, on the old principle, by a light weight moving with great velocity, than the state of the heads of the piles as driven by each process. Dr. Greene drew attention to a sketch of two heads of piles, one 56 feet long driven by a monkey of 12 cwt., falling from a great height, and making only one blow in five minutes, and requiring 20 hours to drive it; this, though protected by a hoop of iron, is so split and shattered on the head, that it would require to be re-headed to drive it any further. The other, although 66 feet long, was not even supported by an iron hoop, and the head is as smooth as if it were dressed off with a new plane. It was driven with a hammer 50 cwt. and only 3 feet fall, making 70 blows a minute.

**RAILWAY GRADIENTS.**—Mr. Fairbairn read a communication, the object of which was to show the importance of economizing the first cost of railways, by introducing steep gradients in difficult districts, whereby the expenses attendant upon tunnels, viaducts, and lofty embankments, would be avoided; whilst the author showed that the desired speed might be obtained by increasing the power of the locomotive. Originally, cylinders only of 10-inch diameter had been used, but at the present time, the engines are furnished with cylinders of 14, 16, and 18 inches diameter. The *maximum* speed which had been originally calculated on, was 10 miles per hour, whereas, at the present time, the ordinary speed on the Great Western, with first-class gradients, is 40 miles. The paper was illustrated by many experiments which had recently been made with regard to gradients on the Manchester and Leeds Railway.

Mr. Whishaw confirmed these views by the results of practical experiments to the extent of nearly 4,000 miles, on nearly all the lines of British railways.

**GLOBE OF THE MOON.**—Sir J. Herschell exhibited a model of the globe of the moon in relief, expressing the forms and elevations of its mountains as seen in a good telescope. This beautiful and exquisite work he stated to be the performance of a Hanoverian lady, Madame Witte; modelled by her from actual observation through an excellent Fraunhofer telescope, in a small observatory at the top of her own dwelling-house; the selenographical positions and general contours of the principal craters and other leading features being first laid down on the smooth surface from Messrs. Beer and Maedler's micrometrical measures and charts. The diameter of the model is 12 inches  $8\frac{1}{2}$  lines (Reinland measure,) or one 10,000,000th part of the moon's actual diameter. The scale of heights is, however, necessarily enlarged to double this amount, as otherwise the relief would be too low for distinctness. The material is a composition of mastic and wax, and the whole is worked out in such perfection of detail as to represent *every* visible crater and mountain peak—nay, even the minuter lines

of elevation which streak the so-called seas, &c. in their true forms and conventional proportions. In consequence, when properly illuminated, and placed at 30 or 40 feet distance, and viewed through a good telescope, the artificial is scarcely distinguishable from the real moon. The delicacy and precision of the work can only be appreciated by a microscopic examination. In fact, the whole model is stated by Madame Witte to have been executed with the aid of magnifying glasses. Sir J. Herschell accompanied his explanation of this model with several remarks on the physical constitution of the moon in respect of climate, atmosphere, moisture, &c., and compared its surface with the chart of part of Mount Etna, lent him for that purpose by Baron von Waltershausen, and with a drawing of his own of one of the principal craters as seen in his 20-feet reflector—placing the volcanic character of the ring mountains beyond all doubt. By the aid of a large chart by Messrs. Beer and Maehler, several of these, such as Aristarchus, Tycho, Kepler, Copernicus, &c. were pointed out, and their peculiarities described—their places on the model being fixed by the aid of brass circles, representing the moon's equator and meridians. This work, it is understood, will be submitted to the inspection of the Astronomical Society, on the resumption of their meetings in November. Speaking of the climate of the moon, Sir J. Herschell considered as probable the attainment of a very high temperature (far above that of boiling water) by its surface, after exposure to unmitigated and continual sunshine during nearly a whole fortnight. The moon, therefore, when at the full, and for a few days after, must be, in some small degree, a source of heat to the earth; but this heat, being of the nature rather of culinary than of solar heat (as emanating from a body below the temperature of ignition,) will never reach the earth's surface, being arrested and absorbed in the upper strata of an atmosphere where its whole effect will necessarily be expended in the conversion of visible cloud into transparent vapor. The phenomenon of the rapid dissipation of cloud (in moderate weather) soon after the appearance of the full moon (or of a moon so nearly full as to appear round to the unassisted eye,) which he stated himself to have observed on so many occasions as to be fully convinced of the reality of *a strong tendency in that direction*, seemed to him explicable only on this principle.

ON THE PROJECTION OF A STAR ON THE DARK LIMB OF THE MOON, *just before its Occultation.* By Prof. Stevelly.—This the Professor considered to be a result of diffraction. Sir Isaac Newton having observed the shadow of a hair placed in a strong beam of sunlight to be broader than the hair itself, was led to investigate the course of a ray as it passed by the edge of a body, like the edge of a knife placed across a hole in a window-shutter, through which a sunbeam is admitted. At some distance the rays proceeded in their usual straight courses; while he found that, at a certain distance, they were bent towards the edge; but the courses of the nearest rays were bent away from the edge, so as to form curves convex towards it. The undulatory theory enabled us to trace these curves, and they were known to be of the nature of the hyperbola,

with asymptotic branches extending onwards from the diffracting edge. Prof. Stevelly conceived the dark limb of the moon to be such a diffracting edge to the slender beam of light which reached us from a fixed star; and that as the curve was at the last moment the light was allowed to pass convex towards the moon, the portion of the ray which last entered our eye before the star disappeared, being the direction in which we should then see the star, if produced backwards, would meet the moon on her dark surface.

Sir D. Brewster said that if two observers were placed near one another, one will see the phenomenon and another will not. Besides, if it arose from the cause supposed by Prof. Stevelly, it should be observed when the edge of a distant spire or other terrestrial object appeared to pass over a star, which he was not aware had ever been noticed. In his opinion, the cause of it was the light of the star passing occasionally through small spots in the atmosphere, which differed from the surrounding portions, producing an effect on the image of the star something like mirage.—Prof. Challis observed, that if so, the edge of the moon would be rendered discontinuous at that part.—Sir D. Brewster replied, that the new property of the retina which he had described yesterday, supplied an answer to that objection; for it appeared that when two parts of a luminous line were disconnected, the retina filled up the chasm, and rendered the line continuous.—Sir W. Hamilton said he considered it rather favorable to Sir D. Brewster's view, that in some states of the atmosphere, he had observed the edge of the moon notched, particularly when she was near the horizon.

ON THE CHEMICAL CHANGES OCCURRING IN IRON FURNACES, by *Dr. Lyon Playfair*, and *Prof. Busen*.—This report went very extensively into the various methods adopted by the authors to insure an accurate determination of all the gaseous products of the hot-blast iron furnaces. It was found that coking was effected in the furnace to the depth of 24 feet. That the distillation of coal reached its maximum at the depth of 14 feet—That the formation of tar took place at between 17 and 14 feet. Hence the coal had to travel 24 feet from the mouth of the body of the furnace to the boshes, to be entirely coked. A great diminution of oxygen is found to occur at those points where the gases become developed, and hence they pass away without undergoing combustion—and it has been estimated that 91 per cent. of the heating material in the form of gaseous products are lost in the hot-blast furnaces. The combustible gases driven off from the furnaces were expelled with a force superior to that used in driving coal gas through the mains for the purpose of lighting towns. These matters having been thoroughly examined—and all the gaseous product submitted to analysis, many of the results being of a very curious character—the authors suggest the propriety of building a canal just above the point at which the gases are given off, for the purpose of conveying these products to other parts where their high heating and illuminating powers may be employed advantageously. These gases in combustion, with a due

supply of oxygen, would give a temperature higher than is necessary for smelting iron; and although the authors do not propose that it should be used for that purpose, they suggest the advantage of employing that waste material for heating steam apparatus—and many manufacturing processes.

ON THE MANUFACTURE OF A COLORED GLASS, by *M. Splittgerber*. Specimens of glass were exhibited, into the composition of which gold entered as a chloride. These specimens were white, but upon gently heating them in the flame of a spirit lamp they became a deep red, transmitting the red rays of light only. If again the same red-dened glass is exposed to the heat of an oxygen blow-pipe it loses nearly all its color, a slight pinkness only remaining. *M. Splittgerber* considers these results to arise from the oxidation of the chloride of gold in the siliceous compound.

ON THE VENTILATION OF COAL MINES, by *Prof. Ansted*.—Prof. Ansted gave an outline of the methods of working coal mines, and then proceeded to narrate the particulars of certain accidents, the circumstances of which seemed capable of suggesting improvements in future; and he referred more particularly to the fact, that, in the Haswell explosion, a considerable number of the persons employed in other panels might have been saved if the communication between them had been more effectually shut off, and if, also, there had been a separate passage or air-drift to the upcast shaft. He also described the explosion in the Killingworth Colliery, where, if the Davy lamp had been in use, the accident would, in all probability, not have happened; and Prof. Ansted urged the necessity of certain conditions being observed in all collieries. 1. That there never should be less than two shafts, because an explosion can scarcely happen without destroying the partition at the bottom of the shaft, and thus checking or entirely stopping the ventilation. 2. That the *panels* should always be of moderate size, and the air-courses never exceed a certain length. 3. That separate air-drifts should always be made from distant workings direct to the pit bottom. 4. The exclusive use of the Safety Lamp in those mines, at least, where the escape of gas from fresh workings, faults, &c., rendered the working at all dangerous.

Prof. Faraday said, the subject of mining accidents had long occupied his attention. The more he pursued the inquiry, the more he was disheartened at the apparent hopelessness of finding out any good general remedy. The explosions were not simply the effects arising from the mixture of gases, but from the combustion of the coal-dust and coal-gas which the first explosion made. In the fatal case at Haswell, the place where the accident originated had been ascertained; and the progress of the fire could be traced on the scorched beams and props of the galleries, and the deposits of coke made from the coal-dust which the explosion raised. To this circumstance the great force of the explosion was due, and not to the first escape of gas. A similar explosion had been known to take place in a cotton-wadding manufactory, the whole atmosphere of the place being fired by means of the particles of cotton in it. Of all the workmen killed in the

Haswell accident, perhaps not one was really burned to death, but suffocated by the *choke-damp*. In one part of the workings the explosion had produced sharp vibrations, like the firing of gunpowder, and in another the burning went on slowly, like a common fire. But although two panels were blown into one, and solid stoppings of brickwork thrown down, there was no indication of the accident in the shaft. If the stoppings had not been blown down, and the supply of air had continued, the mine would have taken fire, and the men been burnt instead of choked. Since the late investigation, Mr. Faraday and Mr. Lyell have had many hundred plans submitted to them, urging ill-considered and contradictory measures. They had examined every part of the Haswell Colliery, accompanied by the mine-viewer, and received recommendations from the best-informed men upon the spot; and they were convinced that the conditions under which the accident happened were so variable, that no general practical rule could be obtained. Far more information, however, was required. The plan of splitting the air-courses was good, as far as the power of the upcast shaft admitted; but, if carried too far, it would produce stagnant points, which could not be prevented by any arrangement consistently with the ever-moving condition of the works. The abolition of the use of gunpowder and lighted candles would, in some cases, double the price of coals. But the great source of danger was the mental condition of the miners. With regard to the present race this was so hopeless, that nothing could be done for them; although smoking was strictly forbidden, they had been known to contrive to light their pipes in dangerous workings even from the Davy lamp; and Mr. Faraday had himself on one occasion sat down with an open candle to watch the preparations for blasting, and when he inquired for the gunpowder was told he was sitting on it. Mr. Faraday took an opportunity, also, of expressing his firm conviction of the safety of the Davy lamp when properly used, and of its being a complete and practical contrivance, to which he would willingly trust his own life, as he had already done on many occasions.

ON THE INFLUENCE OF GALVANIC ELECTRICITY ON THE GERMINATION OF SEEDS, by *Prof. E. Solly*.—In a series of experiments, in which the seeds of barley, wheat, rye, turnips and radish were exposed to the influence of a feeble current of electricity, the plants came up sooner and were healthier than others that had not been electrified. On the other hand, a number of experiments on other seeds had given opposite results,—proving, either that the germination of some seeds was retarded whilst that of others was facilitated by electricity, or that the effects observed in both cases were accidental. Out of a series of 55 experiments on different seeds, 21 appeared in favor of electricity, 10 against it, and 25 showed no effect whatever; and in carefully counting the whole number of seeds up in the entire series, there were found 1,250 of the electrified, and 1,253 of the non-electrified. In conclusion, Prof. Solly stated that he felt doubtful whether the effects observed were really due to the influence of electricity.

JOURNAL  
OF  
THE FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY.

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NOVEMBER, 1845.

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CIVIL ENGINEERING.

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*Description of the Great Britain Iron Steam Ship, with Screw Propeller; with an Account of the Trial Voyages. By THOMAS RICHARD GUPPY, Esq., C. E.*

[From the Proceedings of the Institution of Civil Engineers.]

The Great Western Steam Ship Company originated with a few directors and proprietors in the Great Western Railway Company, who entertained the idea, that, on the completion of the railway from London to Bristol, a direct line of communication, by means of steamboats, to New York, as the focal point of the New World, might be established with advantage.

Hitherto, attention had been directed to the south-western harbors of Ireland, and the nearest ports in America, as the extreme distance between which steamboats of the greatest power then supposed to be practicable, would be enabled to carry a sufficient quantity of coal for the voyage; but this company, placing confidence in the opinion of Mr. I. K. Brunel (their engineer,) ventured to build the *Great Western*, a steamer exceeding in size any that had previously been constructed, and with engines of so much greater power, that the predictions of many experienced and scientific men were unfavorable to the project.

The *Great Western* did, however, fulfil the expectations entertained of her by her projectors, in all respects, except in that, like many other moderate-sized steam vessels, so large a part was occupied by the machinery, relatively to that which could be appropriated to pas-

sengers and goods, the deficiency of space was soon found to operate disadvantageously in a pecuniary point of view.

At first it was intended that their second ship should be of timber, but the superior advantage which the introduction of iron appeared to hold out, induced a very careful comparison, and an investigation into the state of some small steam vessels already constructed of this material, and the result was the abandonment of the previous resolution.

As no example of an iron steam-ship of sufficient size existed, on which to base any calculation of the thickness of the iron to be employed in its construction, or of the disposition of the material, in order to obtain the greatest relative degree of strength, much consideration was requisite, and it became necessary to organize an establishment for building iron instead of wooden ships, before the keel of the new vessel was laid.

The principal dimensions of the hull of the *Great Britain*, are—

	Ft.	In.
Length of keel,	289	0
Length aloft,	322	0
Main breadth,	50	6
Depth of hold,	32	6

The tonnage, according to the usual mode of builders' measurement, is therefore, 3,444 tons.

The weight of iron used in the hull is about 1040 tons; which is equal to an average thickness of  $2\frac{1}{4}$  inches.

The weight of the wood-work in the decks, fittings, &c., is about 370 tons.

And the weight of the engines and boilers (exclusive of the water) is 520 tons.

The total weight, therefore, is 1,930 tons; which, at a draft of water of 10 feet 6 inches forward, and 13 feet 7 inches aft, corresponds exactly with the calculation of the displacement of the hull, which is as follows:—

Draft.	Fore Body.	Aft Body.	Total.
Feet.	Tons.	Tons.	Tons.
12	1053	851	1904
14	1315	1099	2414
16	1594	1386	2980
18	1904	1714	3618

She will therefore be able to take 1000 tons of coal, and 1000 tons of measurement goods, weighing perhaps 400 tons, at a draft of 17 feet forward, and 17 feet 6 inches aft.

The keel plate consists of plates  $\frac{7}{8}$ ths of an inch in thickness, by 20 inches wide, which were welded into lengths of 50 feet to 60 feet, and these lengths were joined together, by very accurately made scarphs, 1 foot 6 inches in length, and riveted all over, at distances of  $4\frac{1}{2}$  inches apart.

The end pieces of the keel, which are more liable to touch the ground, are full 1 inch in thickness.

The stem is 12 inches deep at the forefoot, by 5 inches thick, and at the 8 feet water mark, it is 16 inches by  $2\frac{1}{2}$  inches; thence it diminishes gradually to 12 inches by  $1\frac{1}{2}$  inch. It is welded in one piece 18 feet long.

The ribs or frame are formed principally of angle iron, 6 inches by  $3\frac{1}{2}$  inches by  $\frac{5}{8}$ ths inch, at distances of 18 inches from centre to centre, but inclining gradually to 24 inches at the extremities, where, also, angle iron, 6 inches by  $2\frac{1}{2}$  inches, and 4 inches by 3 inches, is used.

In that part of the body of the ship which is occupied by the engines, the ribs are doubled, by having a similar angle iron riveted to them, with the web inside, or, as it is termed, "reversed."

The outside plating commences with plates 6 feet to 6 feet 6 inches long, and 3 feet wide, by  $\frac{11}{16}$ ths inch thick; of these plates there are four courses; these are followed by several courses of  $\frac{3}{8}$ ths inch thick, which is the strength of the whole of the immersed part, up to the deep load water line.

Above that height the same thickness is preserved amidships, but it is gradually reduced to  $\frac{3}{8}$ ths inch thick quite high up, and at the extremities, with a view to lighten them.

The longitudinal floor sleepers are ten in number; they are 3 feet 3 inches in depth, and  $\frac{1}{2}$  inch and  $\frac{7}{16}$ ths inch thick.

The middle sleepers extend throughout the length of the vessel; those on the sides are level on their upper surface, and consequently are terminated by the rising of the bottom of the ship.

These sleepers are tied to the bottom, and are preserved in their vertical position by inverted curves of strong angle iron, which are riveted to the ribs and also up their sides.

Along the upper edge of each, there is an angle iron, and over the whole is riveted an iron deck  $\frac{3}{8}$ ths inch in thickness.

There are two bilge keels, consisting of a middle plate,  $1\frac{1}{4}$  inch thick, and two angle irons, 5 inches each way by 1 inch thick.

These bilge keels are 110 feet long, and their under edges are on the same horizontal level with the under side of the keel, so that in docking the ship, if long baulks of timber are extended across the dock by way of blocks, the weight of the body of the ship (where the boilers and machinery are placed,) is supported at given parallel distances on both sides of the keel, all risk of straining it, or the machinery, is avoided, and the vessel is not obliged, in the usual manner, to rest upon her keel, until the bilge shores can be got under.

The upper cargo deck forward is made of plate iron,  $\frac{5}{16}$ ths inch thick in the middle, and  $\frac{9}{16}$ ths inch thick round the sides; it is riveted together throughout, as well as to the iron deck beams, and to the sides of the vessel.

The main deck is made of pine timber 5 inches thick, and the planks are cross-bolted at distances of 4 feet apart.

As this deck is situated on the load floatation plane of the vessel, where transverse stiffness is of more importance than longitudinal strength, the planks are placed athwartships, and their extremities firmly bolted down, through two longitudinal stringers of Baltic tim-

ber, to the shelf plates which are 3 feet wide by five-eighths of an inch thick, and are very securely fixed to the sides.

The middle or promenade deck is also of pine timber 4 inches thick, placed lengthwise of the ship; it has also strong iron shelf-plates 3 feet wide by  $\frac{1}{2}$  inch thick, and Baltic stringers to attach it to the side of the ship.

The upper deck is of red pine timber, and is also placed lengthwise. As the sides of the vessel at this height, and also this deck, may be considered as the truss, which is to resist longitudinal deflection, or drooping of the extremities, the outside plates are there  $\frac{1}{2}$  inch thick, and they have been strengthened by an outside moulding-iron strap, 6 inches by 1 inch, and by additional straps of iron 7 inches by 1 inch, welded into lengths of 60 feet, and riveted to the inner sides of the upper line of plates.

The shelf-plate of the deck is 3 feet wide by  $\frac{1}{2}$  inch thick, and upon this, outside of the water-way plank, which is  $4\frac{1}{2}$  inches thick, there is a course or tie of Baltic pine timber 340 inches in section, carefully scarphed and securely bolted to the ribs, and to the shelf-plate, throughout the length of the ship. There are three rows of timber pillars, or stauncheons, which are fixed to the bottom of the ship, passing up between longitudinal ties at each deck, and are secured to the upper one.

The beams of all these decks are made of angle iron, 6 inches by  $3\frac{1}{2}$  inches by  $\frac{1}{2}$  inch, and their ends are bent down, and riveted to the ribs on each side.

Upon them, the shelf-plates before mentioned are riveted, and thus form a horizontal band 3 feet wide at each deck.

A crutch or strut is introduced at each end of nearly every deck beam, which is riveted to it, and to the ribs at about 3 feet from the angle of junction.

One of the most important improvements which has recently been introduced in the construction of vessels (particularly those of iron,) is the water-tight bulkhead; as in the greater number of cases, when an injury may be sustained in one compartment only, it may absolutely preserve a vessel from sinking; several instances of this have already occurred, and even where it may not suffice for this purpose, it at least separates the leaky and injured from the secure parts, and gives time either to attempt to stop the leak, or to make other preparations.

In iron vessels, these bulkheads can be rendered much more effectual than in wooden ones, by their exact contact with the bottom and sides, while at the same time they form admirable ties and stiffeners.

In the *Great Britain* there are five such bulkheads.

The first separates the forecastle from the forward passengers' cabin and the hold, and as it is in the forepart of a vessel that injury is most likely to be sustained, this partition is made particularly strong and secure.

The next bulkhead divides the forward cabin from the engine room or more properly, from the fore-hold for the coal and the stokers, at the forward end of the boilers.

The third bulkhead is abaft the engine-room, but in this, there is necessarily a hole for the screw-shaft to pass through; this is secured by a well-fitted collar, and there is also a door, which is so arranged as to be shut and bolted quickly.

These three bulkheads pass up to the upper deck; there are also two others; one separating the after coal-hold from the after cargo-hold, and another nearly at the stern; both these terminate under the saloon deck.

The minute detail of the construction of the hull of the vessel would be too voluminous to be given here, and it would be unnecessary, as it will shortly be published. It is better, therefore, to proceed to describe the action of the screw propeller, which has now become an object of such deep interest to all who are engaged in marine engineering; and to the machinery by which it is to be put in motion.

At an early stage in the construction of the *Great Britain*, but not until her sides had assumed the form adapted for paddle wheels, the small steamer *Archimedes*, belonging to the Company owning the patent of Mr. F. P. Smith for the application of the Archimedean screw, visited Bristol, and amongst other parties invited to make an excursion to the Holmes, on board of her, were some of the Directors of the Great Western Steam-ship Company.

The performance of the screw on that occasion, induced the author to request permission of Mr. Smith and Captain E. Chappell, R. N., who was officially appointed by the Admiralty to report upon her, to proceed in her to Liverpool.

On the passage, enough rough weather was encountered to show that the screw possessed several good points, and was not so absolutely impracticable as had been asserted; and although far from venturing to give a decided opinion, on the author's return, he wrote such a letter to the Board of Directors as induced them, after some days of deliberation, to decide upon suspending, during three months, the progress of the machinery for paddles, and also of that part of the vessel which might be affected by the change, to call upon Mr. Brunel during that period to investigate the subject.

At the end of the proposed delay, the report which Mr. Brunel made was so favorable, that, undaunted by the novelty and vastness of the experiment, the Directors resolved to adopt this mode of propulsion, of the success of which they have now such cause of congratulation.

From that period, until it became necessary to decide on the exact form of screw to be used, all possible means were taken, by experiment and observation, to arrive at the best shape and angle of inclination of the blades, or as it is commonly called "the pitch."

Amongst others, the proprietors of Mr. Smith's patent liberally lent the *Archimedes* to the Great Western Steam-ship Company, for a period of several months, which afforded ample opportunity of trying the performances of the several forms of screws recorded in the Table given in the next page.

These experiments were made in the Bristol Channel, under circumstances of weather, as nearly as possible similar, and the distances

were very carefully measured by two of Massey's Logs, whose accuracy had been previously tested.

It will be observed, that the greatest velocity of vessel, 8.375 knots, was attained by Mr. Smith's screw of five feet 9 inches diameter, the angle of which was  $19\frac{3}{4}$  degrees, and the slip was 21 per cent.; that is, the ratio of speed of the vessel to that of the screw, was as .787 to 1.

Particular attention is due to experiments Nos. 5, 6, and 7.

Reasoning upon the assumption, that the effort of the entering edge of each blade must cause the water to recede, and that each succeeding portion of blade should so increase in pitch as to impinge with uniform force against the water, which was so receding, a screw of this description was made and tried before it was discovered that it was the subject of a patent by Mr. Woodcroft.

The first trial served to show, that the curvature or increase of pitch which had been given to it was too great, since the speed of the vessel was greater by two per cent. than that due to the mean pitch of the screw, whence it was evident that the entering edge was really retarding, and the terminating portion alone was doing the duty.

Number of Experiment.	Stroke of Engines per Minute.	Horse Power by Indicator.	Speed of Vessel in knots.	Speed of Screw in knots.	Ratio of Speed of Vessel to 1. of Screw.		Diameter of Screw.		Pitch.	
							Ft.	In.	Ft.	In.
1	25.41	67.10	8.375	10.646	.787	Smith's two half threads, made of wrought iron.	5	9	8	0
2	20.75	53.70	8.160	10.880	.750	Ditto. ditto.	5	9	10	0
3	26.25	63.59	7.550	8.230	.917	Ditto, made of cast iron,	7	0	6	0
4	20.50	57.13	7.420	8.520	.870	Ditto. ditto.	7	0	8	0
5	20.	57.30	8.175	8.	1.020	Woodcroft's increasing pitch, 3 blades, made of cast iron, as first made.	7	0	7	$7\frac{7}{8}$
6	21.50	62.60	8.10	8.10	1.	The same, with 3 inches cut off the entering edge of the blades.	7	0	7	$2\frac{1}{8}$
7	22.50	62.12	8.20	8.730	.940	The same, with 4 inches cut off the entering edge of the blades.	7	0	7	5
8	20.50	51.40	7.490	8.566	..	Four wrought iron arms, with blades, each 2 feet 9 inches long by 1 foot broad.	7	0	8	0

On the second trial, when a radial strip 3 inches in width had been cut off the after part of each blade, the speed of the vessel was exactly that due to the screw; whence it was also evident, that the front edge still did not assist.

On the third trial, after a second radial slip of 4 inches had been cut off the entering edge of each blade, the vessel attained a speed of 8.2 knots, and the ratio of speed of the vessel was as .94 to 1 of the screw.

The horse-power employed on this trial, was by indicator, 62.12, and the speed of the vessel 8.2 knots, against 67.1 in the before-named trial, with the original screw of the *Archimedes*, when the speed she attained was 8.375 knots.

Although on neither of the trials numbered 5, 6, and 7 with this screw, was so great a speed of vessel attained as on that first named, it is important to draw attention to the fact, that the slip was reduced to a very small quantity.

But the horse-power exerted was also much less than in the first trial, arising from some imperfections in the cutting down of the screw and other causes, which would probably have been remedied had there been time to cast a new screw of this description; but unfortunately, just at this period, the Propeller Company required the *Archimedes* for service, and the experiments ceased.

This screw was afterwards tried by Mr. Barnes in the *Napoleon*, a very beautiful French Post-Office vessel, built by M. Normand, of Havre, when the following result was obtained :—

Horse Power exerted, 95.5.

Speed of vessel, in knots, 10.15.

Speed of screw, 11.2.

Speed of vessel to 1. of screw,  $.895 = 10\frac{1}{2}$  per cent.

In the two cuttings down, this cast-iron screw with three blades, 9 feet in diameter, which was originally very slight, had been so much reduced in substance, that it weighed only 833 lbs. Mr. Barnes, therefore, could not venture to permit the engines to exert their full power, otherwise it is probable that a higher speed would have been attained.

The commencing angle is  $17^\circ$ , and the terminating one  $19\frac{1}{2}^\circ$ ; the increase of pitch is therefore  $\frac{1}{1\frac{1}{2}}$ th, or  $8\frac{1}{2}$  per cent.

The screw of the *Great Britain*, which is of wrought-iron, consists of six arms, formed by placing and riveting together four distinct forgings, or centre pieces, with arms welded to them, each of which is 6 inches thick.

Upon the extremities of these are riveted palms of plate iron, which are 4 feet  $4\frac{1}{2}$  inches long on their circumferential edge, by 2 feet 9 inches in height, and  $\frac{3}{8}$  inch thick.

The diameter is 15 feet 6 inches, and the pitch or helix of one revolution is 25 feet, which equals an angle of 28 degrees.

Its weight is 77 cwt.

The area of the six palms, which may be considered as the effective part of the screw, is 56.25 feet; but the area, calculated as a plane perpendicular to the axis, that is as portions of a disc, is only 47.4 feet, and the portions of the arms within the blades, present a similar area of 26.88 feet.

As the rotary velocity of the outer edge of the blades is nearly 30 miles an hour, it is important, in order to diminish friction, that they should be as accurately shaped as possible, and should present no irregularities of surface. In this instance, the object was attained, by mounting the screw on a face plate and planing the surface, by means

of a tool, to which the proper motion was given; after which it was painted several times, rubbed very smooth and varnished.

On the second trial of the *Great Britain*, on the 20th January, in the Bristol Channel, in smooth water and during a calm, the engines attained the speed of  $18\frac{2}{3}$  strokes per minute, when the speed of the vessel through the water, measured by an experienced seaman, with the common log, was  $12\frac{1}{2}$  knots.

$$18.66 \times 2.948 \times 25 = 1375.242 \text{ feet, velocity of the screw}$$

$$12\frac{1}{2} \text{ knots} \times 101.2 = 1247.796$$

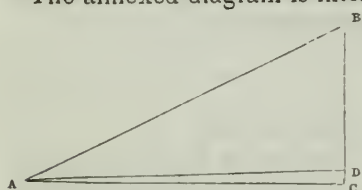
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127.446 slip,—

thus the speed of the vessel was .907 to 1. of the screw.

The area of the midship section of the ship, at the time of this experiment, was 480 feet.

The annexed diagram is intended to illustrate this effect thus:—



The angle subtended by A, B, C, is an entire revolution of a screw 15 feet 6 inches diameter and 25 feet pitch, of which B, D is the forward effort communicated to the vessel, and C, D is the slip, or yielding of the water. Consequently, although the apparent angle of the screw is represented by A, B, C, the real angle is only A, C, D, since A, B, D represents the velocity of the vessel.

To be Continued.

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### *The case of the Yarmouth Suspension Bridge over the river Yare.*

An accident to this bridge, involving an extensive loss of life, occurred on the 2nd May last, arising from the excessive load upon one side of the bridge, of a great concourse of human beings assembled to witness the exploits of five geese, consisting of a clown and four geese proper. The government having appointed Mr. Walker, C. E., to examine into the causes of the catastrophe, he drew up an elaborate report on the subject, of which we give the following abstract:—

“The bridge belonged to the late Mr. Cory, father of the present owners, and was constructed from a design of Mr. Scoles’, an architect in London. At first it was only a substitute for a ferry over the river Yare to the marshes. Mr. Scholes states, that he made designs for a bridge of sufficient width for a carriage and two footways. It appears that the work was offered for competition, and that Mr. Goddard (who is since dead) was the contractor for the bridge work, according to specifications prepared by Mr. Green, a surveyor at Yarmouth. These specifications describe that the iron shall be of the best charcoal iron; but make no mention as to the quality of the iron being tested. From a drawing which is now in Mr. Scoles’ possession, there appears no reason to doubt that the main or suspending chains, and other parts of the bridge, are of the size which were intended.

There were altogether four suspending bars, two on each side to form a chain. These bars were connected together by bolts passing through opening or eyes at each end of them. These bars were  $2\frac{1}{2}$  inches wide by seven-eighths thick; from them rods of 1 inch square were suspended to carry the roadway, which was 14 feet 9 inches in width, and divided, by an iron kerb or carriage-way, from a footpath on each side, 4 feet in width. The length between the centre of the towers is 92 feet; the deflection of the chains was 7 feet 4 inches. An Act of Parliament, constituting the bridge a turnpike road was passed in May, 1830, and the road was opened in 1832. In 1842, the Yarmouth and Norwich Railway Act was passed, which contains a clause by which this bridge was constituted the only communication between the Railway station and the terminus, Mr. Cory agreeing to receive the tolls, stipulating to widen it, and afterwards to suspend it. It appears that on this occasion Mr. Scoles was again consulted, respecting the widening of the carriage-way to a width sufficient for two carriages to pass abreast—the footway being formed on each side by planks, separated by iron straps attached to the framing of the bridge. This footway was therefore outside the suspending chains. That was in 1844.

The foundations appear to have been piled well, and to have stood well. Mr. Scoles showed Mr. Walker a drawing of the piling, and, if the work had been executed according to that, Mr. W. had very little doubt of the soundness of the foundation. It is stated that the crowd collected on the 2d of May, was confined to the south side; that the crowd was composed chiefly of children in the front rank, with adults behind, to see some exhibition which was to be seen on the water. They were supposed to be four or five feet deep, and it appears that they had collected on the bridge to the number of from 300 to 500. One of the witnesses before the inquest stated that he heard a crack overhead, which induced him to look up, when he saw that one of the bars or rods of the suspending-chain was broken—that two points where the fracture had taken place were entirely separated, and that in about five minutes afterwards came the fatal catastrophe. This cracking was no doubt occasioned by the snapping in pieces of the bar which first gave way. There was now only one bar left to support the whole weight, and this bar consequently gave way in five minutes after the one on the other side; the platform, being then entirely unsupported, fell into the river. In forming these bars, the two ends had been forged separately, and then welded to a third piece, a straight bar, by scarphed or diagonal joints. It was at the weldings that the bars gave way. On examining the fracture of the bar which first broke, the weldings were found to be imperfect, inasmuch as evidently not more than one-third of the surfaces were united. It was found on comparison that the second bar had stretched one inch longer than the other: this must have happened during the five minutes when it had singly to bear the strain. The qualities of the pieces of iron being tested, the middle or straight parts were found greatly superior to the ends. A piece of one of the ends was very open and coarse grained, and broke off like a piece of cast-iron when a hammer was

applied to the *middle* of the bar, another point altogether. Had the bar been perfectly tested, the defect could not have escaped detection. Another bar was tested as to fibre; it broke in pieces like a carrot. As to the strength of the bridge compared with the load, taking the load at the time of the accident to be all on the south chain, it is found by calculation that the two rods of  $2\frac{1}{2}$ " by  $\frac{7}{8}$ " are capable of sustaining a temporary load of 56 tons, without injury. Taking 400 individuals at 7 stones weight each, with the weight of the bridge, at 400 tons, the strength of the bars would exceed the load. The excess, however, was not sufficient, as at all times large allowances ought to be made for imperfections. The bridge appears to have been by no means too strong before the additions were made; and after this was done, the effect was most injurious, as the weight was placed outside the suspending chain. "In reference to the sufficiency of the bridge," he says, "to carry the greatest load which could be placed upon it, I find that its strength is somewhere a little above the weight which it would carry, but so small as not to be practically sufficient, even without any allowance for imperfections. Even before the additions were made, it appears not to have been sufficiently strong to insure perfect security, supposing a mass of people to have been packed upon it in the way in which I have described. It appears that on other occasions a very great number of persons had been upon the bridge, and that it had borne them without falling. When a bridge has been frequently loaded, to the utmost which it will bear, it becomes weaker and weaker each time, and the bridge may ultimately give way, although at first it was sufficiently strong to resist the weight put upon it." On the whole, therefore, witness had come to the following general conclusions:—

"1. That the immediate cause of the accident was a defect in the joining or welding of the bar which first gave way.

"2. That the quality of the iron and the workmanship, as far as I have been able to examine them, is defective; and I believe that the accident would not have happened had the work been properly examined at the time of construction.

"3. That the widening appears to have been made without sufficient reference to the original strength of the bridge, and the weight which it had to support, and therefore that it acted as an aggravation of the evil.

"4. That in the original construction of the bridge, the casualty of a great load all on one side does not appear to have been contemplated; if it had been, I think that the links on that side would have consisted of more than two bars, any one of which was unequal to the load which the bridge was likely to carry."

Mr. Walker added, that the weight of the bridge, including the suspending chains, before the additional width was added, was 17 tons, 14 cwt. 3 qrs. 25 lbs.: with the additional width, and the railing added, its weight was 20 tons 8 cwt. 9 lbs., making an addition of 2 tons 13 cwt.

Glasgow Prac. Mech. & Eng. Mag.

### *New Railway Bills.*

It appears, from a table published in Herapath's Railway Magazine of August 23rd, 1845, that bills were passed during the late session of Parliament, authorizing the construction of 113 new lines of railway. These new roads are found in almost all parts of England, Scotland, Ireland, and North and South Wales.

The most important line appears to be the "South Wales," of which the length is 182 miles, and the authorized capital in shares £2,800,000, and in loan £933,333.

The next in importance is the "Caledonian," 135½ miles long, with a capital of £2,100,000 in shares, and £700,000 authorized loan.

The 113 bills embrace new railway lines, of which the aggregate length is 2,944½ miles, the aggregate capital in shares, £42,818,330, and authorized loan £14,541,791—making the authorized expenditure £57,360,121. C. E.

We make the following extracts from the last reports of the two greatest British railways—the London and Birmingham and the Great Western. COM. PUB.

#### *London and Birmingham Railway.*

The capital investment of this Great work now amounts to the enormous sum of £7,256,718 8s. 10d., or about \$34,832,000.

The cost of Locomotive engines to 30th June,

1845, was £184,098    7s.    7d.

Carriages and Wagons, £290,394   17s.   8d.

Total cost of Working Stock, £474,493    5s.    3d.

The Company have charged to *depreciation*  
of Stock from the beginning £199,031

The following is the Statement of Revenue account, &c.

Dr. £.            s.            d.

Maintenance of way and stations—Repairs of the permanent way, tunnels, bridges, drains, &c., 20,694l. 4s. 11d.; engineers' salaries, overlookers, time-keepers' wages, and office charges, 1,530l. 18s. 2d.; repairs of the Aylesbury Railway, 784l. 2s.; repairs of station buildings, 1,133l. 10s. 4d. 24,142   15   5

Locomotive power—Wages of engine-drivers and firemen, 5,994l. 15s. 3d.; coke, 18,459l. 8s. 7d.; oil, hose-pipes, and fire-tools, pumping engines and water, 2,263l. 2s.; laborers and cleaners, waste and oil, 2,413l. 16s. 9d.; repairs of engines and tenders, 8,339l. 16s. 7d.; coals and fire-wood, expenses of stationary engine at Wolverton, repairs of buildings, gas, and incidental charges, 1,895l. 11s. 10d.; Superintendent, clerks, and foremen's salaries, and office charges, 2,196l. 11s. 4d.; cost of locomotive

	£	s.	d.
power for the Aylesbury Railway, 1,598 <i>l.</i> 11 <i>s.</i> 7 <i>d.</i>	43,161	13	11
Police charges, viz.:—Wages and petty disbursements, 5,248 <i>l.</i> 9 <i>s.</i> 11 <i>d.</i> ; clothing, 533 <i>l.</i> 10 <i>s.</i> 6 <i>d.</i> ; gratuities to switchmen, 436 <i>l.</i> ; oil, lamps, flags, &c., 449 <i>l.</i> 2 <i>s.</i> 5 <i>d.</i> ,	6,667	2	10
Coach traffic charges—salaries of booking clerks and petty disbursements, 3,460 <i>l.</i> 12 <i>s.</i> 3 <i>d.</i> ; wages and gratuities to guards, ticket-collectors, and porters, 8,416 <i>l.</i> 1 <i>s.</i> 3 <i>d.</i> ; clothing for the same, 452 <i>l.</i> 6 <i>s.</i> 6 <i>d.</i> ; gas at stations, 1,161 <i>l.</i> 11 <i>s.</i> 11 <i>d.</i> ; oil, coach grease, cotton waste, fuel, water, and repairs, 2,546 <i>l.</i> 8 <i>s.</i> 2 <i>d.</i> ; stationery and tickets, 1,059 <i>l.</i> 14 <i>s.</i> 9 <i>d.</i> ; sundries, including horse-hire, 166 <i>l.</i> 18 <i>s.</i> 2 <i>d.</i> ; loss on light gold, 253 <i>l.</i> 9 <i>s.</i> 3 <i>d.</i> ,	17,517	2	3
Coach repairs, 6,039 <i>l.</i> 1 <i>s.</i> 3 <i>d.</i> ; mileage of carriages employed in through traffic, 44 <i>l.</i> 1 <i>s.</i> 9 <i>d.</i>	6,083	3	0
Merchandize traffic charges, viz.:—Salaries wages horses, gas, and sundries, 2,585 <i>l.</i> 15 <i>s.</i> 5 <i>d.</i> ; wagon repairs, 1,567 <i>l.</i> 11 <i>s.</i> ; less mileage of wagons employed in through traffic, 228 <i>l.</i> 13 <i>s.</i> 9 <i>d.</i> ; 1,338 <i>l.</i> 17 <i>s.</i> 3 <i>d.</i> ,	3,924	12	8
Compensation for damage and losses	463	19	7
Stores department charges,	514	8	4
General charges, viz.:—Advertising, 307 <i>l.</i> 12 <i>s.</i> 11 <i>d.</i> Direction, 850 <i>l.</i> Office charges, viz.:—Secretary's, accountant's, and transfer departments, 2,371 <i>l.</i> 11 <i>s.</i> 8 <i>d.</i> Superintendent's departments, 601 <i>l.</i> 6 <i>s.</i> 6 <i>d.</i> Audit department, 731 <i>l.</i> 0 <i>s.</i> 3 <i>d.</i> Clearing house, 225 <i>l.</i> Sundries, viz.:—Traveling expenses of Directors and superintendents, 413 <i>l.</i> 5 <i>s.</i> 3 <i>d.</i> Dividend and interest receipt stamps, 215 <i>l.</i> 13 <i>s.</i> 3 <i>d.</i> Wolverton schools, and all other charges not classed, 414 <i>l.</i> 18 <i>s.</i> 5 <i>d.</i>	6,133	8	3
	108,608	6	3
Parish rates and taxes,	12,612	18	9
Duty on Passenger traffic,	13,029	12	7
Reserve, for depreciation of locomotive and carriage stock, carried to Capital Account (B 2,) 14,498 <i>l.</i> Do. for the depreciation of works, carried to Capital account (B 1,) 1,000 <i>l.</i>	15,498	0	0
	149,748	17	7
Cr. Traffic, viz.:—	£	s.	d.
Passengers, 293,907 <i>l.</i> 7 <i>s.</i> 6 <i>d.</i> ; mails, 7,445 <i>l.</i> 13 <i>s.</i> 10 <i>d.</i> ; horses, carriages, and dogs, 13,972 <i>l.</i> 0 <i>s.</i> 9 <i>d.</i> ; par-			

	£	s.	d.
cells, (less paid out to agents for delivery) 25,826l. 2s.	241,151	4	1
Merchandise, 98,859l. 0s. 2d.; cattle, 7,180l. 13s.,	106,039	13	2
	447,190	17	3
Interest on loans, balances, and calls in arrear,	3,296	13	4
Rent of lands and buildings, 3,633l. 10s. 5d.; less repairs and charges, 1,239l. 12s. 11d.,	2,393	17	6
	£452,881	8	1

*Report.*

The operations of the last half-year exhibited a great increase of traffic both in passengers and goods, and a considerable excess of receipts over the corresponding half-year of 1844, notwithstanding the large reductions which have since been made in the Company's fares and rates, amounting on an average of the passengers' fares of all classes, from 2·609*d.* per mile in 1844, to 1·818*d.* in 1845; and on the average rates of goods of all classes per ton, from 2·816*d.* per mile in 1844, to 2·636*d.* in 1845.

The total mileage of passengers is 38,758,260 in 1845, against 24,664,979 in 1844, being an increase of 57·143 per cent.

The total mileage of goods is 9,350,718 tons, against 6,929,875—being an increase of 34·933 per cent.

The receipt for the gross ordinary traffic for 1845, is	£447,190
1844, is	405,768

Increase,	41,422
The charge on the traffic for 1845, is	108,382
1844, is	92,823
Increase to charge,	£15,560

The chief increase of charge is in the locomotive department, arising from the additional work required from the engines, which amounted

For the half-year of June, 1845, to	£43,161
Against the charge for 1844, of	32,603

Increase,	£10,558
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But the Directors having made provision, as stated in their last report, for a supply of engines of greater power than those hitherto employed, and better calculated for the extended carrying business of the Company, although disappointed in their delivery as early as was expected, they contemplate a large prospective reduction of expense under this head in the course of next year, when these engines will have been brought into work.

The Directors trust also, that the charge for maintenance of way will be progressively reduced under the operation of new contracts, which, owing to the improved state of the works, they have been enabled to make at lower prices than those previously subsisting.

*Comparative Mileage of Passenger Traffic for the half-years ended 30th June, 1843, 1844, and 1845.*

	Number of Passengers.	Miles traveled.	Average Number of Passengers per day.	Average number of Miles traveled by each Passenger.	Equal to the undermen- tioned No. of Passengers traveling the whole way, (112 miles) per day.
Half-year ended 30th June, 1843,.....	360784	23395261	1982	64½	1147
Half-year ended 30th June, 1844,.....	371331	24664979	2040	60½	1210
Half-year ended 30th June, 1845,.....	615904	38758260	3384	62½	1901
<i>The same for the half-years ended 31st December, 1842, 1843, and 1844.</i>					
Half-year ended 31st December, 1842,.....	407840	26563216	2216	65½	1289
Half-year ended 31st December, 1843,.....	419943	26983182	2282	64½	1308
Half-year ended 31st December, 1844,.....	480367	31122885	2611	64½	1510

*Comparative Statement of half-yearly Traffic Receipts and Disbursements, from July 1, 1842, to June 30, 1845.*

	Half-year ending 31st Dec., 1842.				Half-year ending 30th June, 1843.				Half-year ending 31st Dec., 1844.				Half-year ending 30th June, 1845.			
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£
<b>RECEIPTS.</b>																
Passengers,.....	282595	12	7	9254180	7	11	287333	0	4	268137	4	7	294569	13	4	293907
Mails,.....	7314	19	2	7125	13	10	7314	19	9	7352	4	3	7564	12	8	7445
Horses, carriages, and dogs,.....	18550	16	4	15966	2	6	17122	7	0	15931	3	11	15385	12	0	13972
Parcels,.....	25913	8	4	23125	4	1	25711	17	1	23638	16	8	27417	17	0	25826
Merchandise,.....	79081	13	11	77479	18	11	81276	10	2	84022	11	5	92241	0	7	98859
Cattle,.....	7502	7	6	7256	19	6	13598	13	8	6686	14	6	13300	0	10	7180
	420958	18	0	385194	6	9	432357	7	5	405768	15	2	450478	16	6	447190
<b>EXPENDITURE.</b>																
Maintenance of way and stations,.....	32711	7	7	22451	4	2	22049	18	8	22540	14	3	22767	7	11	24142
Locomotive power,.....	38640	15	1	32853	12	5	34261	4	0	32603	9	7	36145	10	9	43161
Coaching and merchandize charges,.....	34582	13	7	27994	10	1	34742	9	9	31748	2	10	30717	12	10	34650
General charge s.,.....	6966	0	6	6083	9	8	6632	9	11	5930	15	3	6782	13	5	6647
	102907	16	9	89382	16	4	96686	2	4	92823	1	11	96413	10	11	108608

*The Great Western Railway.*

The capital investment of this Company for the main line to June 30th, 1845, was £6,746,533.

For the main road and branches, £6,717,043, or about \$37,041,000.

The following is the Revenue account, from the 1st January to the 30th June, 1845.

*Expenditure.*

	£	s.	d.
Maintenance of way, stations and works,	26,489	17	8
Locomotive account, viz :—coal, coke, repairs, wages to drivers, firemen, &c., oil, tallow, and all other incidental expenses,	47,990	8	4
Carrying account, viz :—Wages to guards and conductors, police, messengers and porters, clothing, repairs of carriages, oil, tallow, &c.,	34,765	9	6
General charges, viz :—Superintendents' and clerks' salaries, advertising, printing, stationery, and sundries, including traveling expenses,	15,014	14	1
Disbursements for repairs and alterations of stations, &c., and for insurance,	337	8	9
Compensation returns and allowances,	569	14	6
Government duty on gross receipts from passengers,	13,274	0	10
Rates and taxes,	12,634	16	0
General offices, for direction, salaries, and all office expenses,	2,290	13	8
	£153,367	3	4
Amount chargeable to revenue for the renewal and depreciation of plant during this half-year,	5,000	0	0
Balance for the half-year, ending 30th June, 1845,	274,929	12	10
	£433,296	16	2

*Receipts.*

	£	s.	d.
Traffic in Passengers,	285,311	0	2
Carriages, horses, and dogs,	11,055	3	0
Expresses,	193	16	0
Mails, including further payment for services to 22nd June, 1844, under award	32,314	13	5
Merchandise, £7,504 <i>l.</i> 14 <i>s.</i> 11 <i>d.</i> Less for compensation allowed for loss by fire, 2,843 <i>l.</i> 2 <i>s.</i> 7 <i>d.</i> ,	84,661	12	4
Warehouse rent,	42	14	7
Parcels,	15,468	15	9
Rent from the Bristol and Gloucester Railway Company, for use of the Bristol station, and of the line between Standish and Gloucester,	3,278	1	8
Rents, &c.,	679	14	3
Registration fees,	291	5	0
	£433,296	16	2



*Railways in Portugal.*

Lisbon, Saturday, July 12.

A council of Ministers was held the day before yesterday for the purpose of taking into consideration and announcing the decision of the Government upon the several railway projects for Portugal, which have been lately submitted. Their Majesties came up from Cintra expressly to preside at this council, and returned thither in the evening.

There were eleven different proposals before the Government, all from foreign Companies, with the exception of one Portuguese. One was French, and the remainder English. These were all independent of the contract already concluded with the Company dos Obras Publicos for the formation of a railway from Lisbon to Badajoz. Of these, the following have been definitely rejected:—The English Company, by Mr. Hyslop, for a railway north from Lisbon by Coimbra to Oporto, and thence to Corunna. The French Company, by Monsieur Jucan, for a railway, likewise north, from Lisbon, by Coimbra, to Oporto, and thence by Braganza into Spain. Two proposals by Mr. Benjamin Oliveira, of London, the chief of which was for a railway from the Cacilhas, on the south side of the Tagus, immediately opposite to Lisbon, by Evora and Bega, to Seville, in Spain. Two proposals by an English Company for the formation of railways in the Alto-Donro, one on the north and the other on the south side of the river, embracing the principal towns on either side, and meeting at Torre de Moncorvo, from whence a single line was to pass into Salamanca, in Spain. The two remaining projects which were rejected were of minor importance, and were to proceed by routes which present no reasonable prospect of traffic to repay the outlay.

The following three projects were entertained, and though the Government has not yet finally bound itself to accept them, they may perhaps be proceeded with:—two proposals by an English Company, by Mr. Clegg, one for the railway from Lisbon to a point between Campo Grande and Benifica (the terminus to be a little northward of the Passeio Publico, or public gardens,) and thence by the coast as far as Cascaes, taking in the small intermediate sea-bathing towns, and to Cintra. The other of Mr. Clegg's proposals is to continue the preceding railway northward by Coimbra to Oporto, and thence by Braganza to Spain. The third and last proposal which has been entertained is one by an English Company, by General Bacon, for the formation of a railway from Lisbon through Alemtejo by Evora to Elvas and Badajoz. An inconvenience connected with the latter project is, that it interferes directly with the contract already concluded between the Government and the Company dos Obras Publicos, for the construction of a railway between the same termini of Lisbon and Badajoz, by a line very little different. The Government is not disposed to meet this difficulty by releasing the Company dos Obras Publicos from this part of its engagement, and holding it responsible for the execution of the other works which it has undertaken—the

construction of roads and canals throughout the kingdom, the circumvallation of Lisbon for fiscal purposes, &c. The Company has deposited 600 cantos (about 150,000*l.*) of forfeit money, and of course as there are two parties to every contract, the company may not choose to forego the railway portion of its agreement. The several parties are now in negotiation, and the result will be speedily known. Senhor Silva Cabral is of opinion that the terms offered by the English company, as compared with those offered by the Portuguese company, are so advantageous to the Government, that the latter has the right of option. General Bacon, in fact, makes the most extensive offers, and appears rather to be on the side of offering too much.

Heraopath's Jour. & Railway Mag.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*The Wire Suspension Aqueduct over the Allegheny River, at Pittsburgh.*

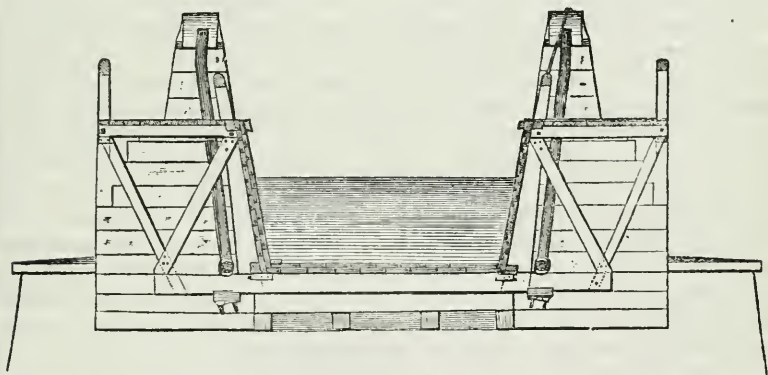
This work, recently constructed under the superintendence of John A. Roebling, the designer and contractor, has supplied the place of the old wooden structure which originally was built by the State of Pennsylvania at the western termination of the Pennsylvania Canal.

The Council of the city of Pittsburgh, by whom, in consequence of an arrangement with the State, the tolls on this aqueduct are of late received, and who are bound to keep the work in repair, decided on re-building, and after considering various plans, adopted that of Mr. Roebling, and entered into contract with him to re-construct the communication, for the gross sum of \$62,000, including the removal of the old ponderous structure and the repair of the pier and abutments; a very small sum indeed for a work of such magnitude. As this work is the first of the kind ever attempted, its construction speaks well for the enterprize of the city of Pittsburgh.

The removal of the old work was commenced in September, 1844, and boats were passed through the new aqueduct in May, 1845.

This work consists of 7 spans, of 160 feet each, from centre to centre of pier. The trunk is of wood, and 1140 feet long, 14 feet wide at bottom, 16½ feet on top, the sides 8½ feet deep. These, as well as the bottom, are composed of a *double* course of 2½ inch white pine plank, laid diagonally, the two courses crossing each other at right angles, so as to form a solid lattice-work of great strength and stiffness, sufficient to bear its own weight and to resist the effects of the most violent storms. The bottom of the trunk rests upon transverse beams, arranged in pairs, four feet apart; between these, the posts which support the sides of the trunk are let in with dove-tailed tenons, secured by bolts. The outside posts, which support the sidewalk and tow-path, incline outwards, and are connected with the beams in a similar manner. Each trunk-post is held by two braces, 2½ × 10 inch, and connected with the outside posts by a double joist of 2½ × 10. The trunk-posts are 7 inches square on top, and 7 × 14 at the heel; the transverse beams are 27 feet long and 16 × 6 inches; the

space between two adjoining is 4 inches. It will be observed, that all parts of the framing are double with the exception of the posts, so as to admit the suspension rods. Each pair of beams is supported on each side of the trunk by a double suspension rod of  $1\frac{1}{8}$ th inch round iron, bent in the shape of a stirrup, and mounted on a small cast-iron saddle, which rests on the cable. These saddles are connected, on top of the cables, by links, which diminish in size from the pier towards the centre. The sides of the trunk set solid against the bodies of masonry, which are erected on each pier and abutment as bases for the pyramids which support the cables. These pyramids, which are constructed of 3 blocks of a durable, coarse, hard-grained sand-stone, rise 5 feet above the level of the side-walk and tow-path, and measure  $3 \times 5$  feet on top, and  $4 \times 6\frac{1}{2}$  feet at base. The side-walk and tow-path being 7 feet wide, leave 3 feet space for the passage of the pyramids. The ample width of the tow and foot-path is therefore contracted on every pier, but this arrangement proves no inconvenience, and was necessary for the suspension of the cables next to the trunk.



The caps which cover the saddles and cables on the pyramids rise 3 feet above the inside or trunk railing, and would obstruct the free passage of the tow-line; but this is obviated by an iron rod which passes over the top of the cap and forms a gradual slope down to the railing on each side of the pyramid.

The wire cables, which are the main support of the structure, are suspended next to the trunk, one on each side; each of these two cables is exactly 7 inches in diameter, perfectly solid and compact, and constructed in one piece from shore to shore, 1175 feet long; it is composed of 1900 wires of  $\frac{1}{8}$ th inch thickness, which are laid parallel to each other. Great care has been taken to insure an equal tension of the wires. Oxidation is guarded against by a varnish applied to each wire separately, their preservation, however, is insured for certain by a close, compact, and continuous wrapping, made of annealed wire and laid on by machinery in the most perfect manner. A continuous wrapping is an important improvement, which, in this case, has been for the first time successfully applied.

A well-constructed and well-wrapped cable presents the appear-

ance of a solid cylinder, which in strength greatly surpasses a chain, made of bars of the same aggregate section or weight. It is not only the great relative strength of wire which renders it superior to bar iron, but its greater elasticity, which enables it to support strong and repeated vibrations, add still more to its value as a material for bridge building.

The extremities of the cables do not extend *below* ground, but connect with anchor chains, which, in a curved line, pass through large masses of masonry, the last links occupying a vertical position. The bars composing these chains average  $1\frac{1}{2} \times 4$  inch, and are from 4 to 12 feet long; they are manufactured of boiler scrap and forged in one piece without a weld. The extreme links are anchored to heavy cast-iron plates of 6 feet square, which are held down by the foundations, upon which the weight of 700 perches of masonry rests. The stability of this part of the structure is fully insured, as the resistance of the anchorage is twice as great as the greatest strain to which the chains can ever be subjected.

The plan of anchorage adopted on the aqueduct varies materially from those methods usually applied to suspension bridges, where an open channel is formed under ground for the passage of the chains. On the aqueduct, the chains below ground are imbedded and completely surrounded by cement. In the construction of the masonry, this material and common lime mortar have been abundantly applied. The bars are painted with red lead. Their preservation is rendered certain by the known quality of calcareous cements to prevent oxidation. If moisture should find its way to the chains, it will be saturated with lime and add another calcareous coating to the iron. This portion of the work has been executed with scrupulous care, so as to render it unnecessary on the part of those who exercise a surveillance over the structure to examine it. The repainting of the cables every 2 or 3 years, will insure their duration for a long period.

Where the cables rest on the saddles, their size is increased at two points by introducing short wires and thus forming swells, which fit into corresponding recesses of the casting. Between these swells, the cable is forcibly pressed down by three sets of strong iron wedges, driven through openings which are cast in the side of the saddle.

When the merits of the suspension bar were discussed previous to the commencement of the structure, doubts were raised as to the stability of the pyramids and the masonry below, when unequal forces should happen to disturb the equilibrium of adjoining spans. It was then proved by a statistical demonstration, that any of the arches with the water in the trunk, could support an extra weight of 120 tons, without disturbance to any part of the work. In this examination, no allowance at all was made for the great resistance of the wood-work and the stiffness of the trunk itself. During the raising of the frame-work, the several arches were repeatedly subjected to very considerable unequal forces, which never disturbed the balance, and proved the correctness of previous calculations.

The stiffness and rigidity of the structure is so great, that no doubt is entertained that each of the several arches would sustain *itself* in

case the wood-work of the next one adjoining should be consumed by fire. The wood-work in any of the arches separately may be removed and substituted by new material, without affecting the equilibrium of the next one.

The original idea upon which the plan has been perfected, was to form a *wooden trunk*, strong enough to support its own weight, and stiff enough for an aqueduct or bridge, and to combine this structure with wire cables of a sufficient strength to bear safely the great weight of water.

The plan of this work, therefore, is a combination which presents very superior advantages, viz., *great strength, stiffness, safety, durability, and economy.*

This system, for the first time successfully carried out on the Pittsburgh aqueduct, may hereafter be applied, with the happiest results, to railroad bridges, which have to resist the powerful weight and great vibrations, which result from the passage of heavy locomotives and trains of cars.

REMARK.—The quantities in the following table are calculated for a depth of water of 4 feet, which has been in the aqueduct ever since the opening. The depth contemplated was  $3\frac{1}{2}$  feet; a greater depth is at present required on account of the raising of the bottom of the canal by bars and sediment, which have to be removed before the level can be lowered.

*Table of Quantities on Aqueduct.*

Length of Aqueduct without extensions,	1,140 feet.
Length of cables,	1,175 "
Length of cables and chains,	1,283 "
Diameter of cables,	7 inches.
Aggregate weight of both cables,	110 tons.
Section of 4 feet of water in trunk,	59 sup. feet.
Total weight of water in aqueduct,	2,100 tons.
"                "                one span,	295 "
Weight of one span, including all,	420 "
Aggregate number of wires in both cables,	3,800
Aggregate solid section of both cables,	53 sup.inch's
"                "                anchor chains,	72 "
Deflection of cables,	14 feet 6 in.
Elevation of pyramids above piers,	16 feet 6 "
Weight of water in 1 span <i>between</i> piers,	275 tons.
Tension of cables resulting from this weight,	392 "
Tension of one single wire,	206 lbs.
Average ultimate strength of one wire,	1,100 "
Ultimate strength of cables,	2,090 tons.
Tension resulting from weight of water upon 1 solid square inch of wire cable,	14,800 lbs.
Tension resulting from weight of water upon 1 square inch of anchor chains,	11,000 "
Pressure resulting from weight of water upon 1 pyramid,	137½ tons.
"                "                "                "                "                "                1 superficial foot,	18,400 lbs.

## AMERICAN PATENTS.

*List of American Patents which issued in the month of February, 1845, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For improvements in the *Cultivator*; R. H. Springsteed, Wooster, Wayne county, Ohio, February 12.

In this cultivator, which is adapted to the planting of seed, the frame is made to expand and contract, like the expansion harrow. The ploughs are arranged diagonally across the frame, and are connected with it by means of journals, to admit of adjustment as the frame is expanded or contracted. The seeds are dropped in two rows, one on each side, by means of cams on the shaft of a running wheel that supports the back of the machine, which cams operate two slides for dropping the seeds.

Claim.—“I do not claim a cultivator with the side beams of the frame moveable, nor do I claim the spreading contracting seed planters, or the extension of shafts as described in my machine, as it has been before used for various purposes; but what I do claim as my invention and desire to secure by letters patent, is the arrangement of the ploughs as herein described, by means of the curved side pieces of the frame, said side pieces being made so that they can be expanded for the purposes herein set forth.

“I also claim in combination with the above, the shaft constructed so as to extend as herein described, combined with, and operating the slides in the hoppers.

“I further claim the construction of the back of the plough as herein described, so as to fasten all the parts by hooking the land slide into the cutter, as described.”

The shaft that carries the cams for operating the slides for dropping the seeds are made with sliding coupling boxes.

2. For an improvement in the *method of Evaporating Brine in the Manufacture of Salt*; James S. O. Brooks, Kanawha county, Virginia, February 12.

The object of this improvement is to apply heat to the brine at the top, as it is believed that this improves the crystalization.

Claim.—“I do not claim applying heat to the surface of the brine for the purpose of crystalizing the salt, as that has before been done, but I confine my claim to the mode herein described of applying the heat to the surface of the brine as that surface rises or falls, by means of the revolving or floating pipe, constructed and operating substantially as herein described. Its advantages are two-fold: 1st preserves a low degree of heat in all parts of the cistern; 2nd is a convenient mode of preventing the currents in the lower strata of brine.”

3. For an *improvement in Door Hinges*; Robert B. Varden, Baltimore, Maryland, February 12.

One half of the hinge is provided with several wings, a plate, or a segment with holes, to receive the end of a sliding pin for the purpose of holding the shutter, &c. in any position desired.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the arrangement of the bolt or pin in combination with the wings and perforated segments and plate on one half of the hinge, or on the shutter, by which means the shutter or blind can be fastened and held in any position corresponding with the holes or wings, as described.”

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4. For an improvement in *Carding Machines*; Hugh Whitman, Pittsburgh, Pennsylvania, February 12.

The patentee says:—“My invention consists in dispensing entirely with the main cylinder of the common carding machine, and disposing the liekerin and the strippers and workers around the lower part of the periphery of the doffer so as to act doubly, both receiving and delivering the material to be carded directly from and to the doffer, without the aid of the main cylinder.”

Claim.—“What I claim as my invention is the dispensing with the main cylinder of the common carding machine, by so disposing of the liekerin and ‘workers and strippers around the lower part of the circumference of the doffer and giving them such motion as to deliver to and receive from the doffer itself, without the aid of the main cylinder.”

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5. For an improvement in the method of *making Wrought-iron Cannon*; Daniel Treadwell, Cambridge, Massachusetts, Feb. 12.

The following claim fully explains the nature of this invention.

Claim.—“I have invented a new and improved kind of cannon, which is formed of a series of rings, or short hollow cylinders, joined together by their ends, in sufficient numbers to form the length required for the cannon.”

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6. For an improvement in the *Wagon Lock*; Daniel D. Gibson and Walker Cobb, Damascoville, Columbiana county, Ohio, February 12.

The body of this carriage slides on the frame, and the brake is jointed to this frame with a lever extending up to the body, so that in going down hill the sliding of the body on the frame forces the brakes against the back wheels; and for the purpose of relieving the brake when the carriage reaches a level, the brake is connected by a chain with the swingle trees, so that the pull of the horses removes it from the wheels.

Claim.—“What we claim as our invention and desire to secure by letters patent, is the mode of operating the brake by means of the body sliding on the frame and connected with the levers of the brake, in combination with the mode of removing the brake from the wheels, by connecting it with the swingle tree, substantially as herein described.”

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7. For an improvement in the *Mill for cutting and grinding Corn-*

*cobs and Fodder*; E. A. Knowlton, Columbia, Richland county, South Carolina, February 12.

This patent is granted for making recesses in the face of the bed stone of a peculiar form, to receive the substances to be crushed, from the eye of the runner, provided with an inclined recess to facilitate the delivery into the recesses of the bed stone. The claim is to the form of the recesses in the bed stone, and also to the combination of these with the recess in the runner. As the claim refers to, and is dependent on the drawings, we are under the necessity of omitting it.

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8. For improvements in the *Machine for Crimping Boots*; Cosman White, Galway, Saratoga county, New York, February 12.

The first section of the following claim needs no explanation, and in the second section, the object of the channel plates in the jaws referred to is to receive, in grooves made therein, projections from the grippers, to steady their operation.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the construction of the two hinged grippers for holding the ends of the leather whilst straining it—that is to say, being made with openings in the lower end of the grippers, beveled on the inside, or wider on the outer than on the inner face, into which are fitted loosely hinged shutters of corresponding size and shape, between which and the gripper the end of the leather is gripped. A projection or cog being formed on the lower end of each gripper, that runs back and forth in the horizontal grooves in the plates in the head of the jaws—the upper ends of the grippers being hinged to the horizontal connecting bar containing the female screw, into which is screwed the vertical male screw, passing through the top of the sliding frame.

“I also claim constructing the jaws with the channeled plates, in the manner and for the purpose set forth.”

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9. For an improvement in the *Summer Baker for Cooking purposes*; John T. Davy, Troy, Rensselaer county, New York, February 12.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the manner in which I have combined the oven and fire-box, (being surrounded by an air chamber perforated through the top plate, with the holes communicating with the oven,) the oven being directly over the fire-box, and the smoke-pipe ascending through the oven, and the flame and smoke being distributed over the top of the oven, in the manner described, these features in combination constituting the economy of my summer baker, the whole arrangement and combination being substantially as herein set forth.”

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10. For an improvement in *Bee Hives and the mode of managing Bees*; Elias Jones, Amsterdam, Montgomery county, New York, February 12.

The patentee says:—“My improvement consists in a certain new and useful combination and arrangement of a horizontal series of parallel perforated tubes for conducting the warm breath of the apiarian

to the vicinity of the joint between the boxes where the separation and division are required to take place, for the purpose of driving the bees to any part of the boxes required whenever it becomes necessary to colonize them, said tubes serving also to sustain the comb in the boxes and to admit air for ventilation and slides for closing them in winter, said slides also strengthening the tubes, to secure the comb attached to them. Also, in the arrangement of other tubes in the sides of the boxes, to admit the breath of the apiarian for directing the bees to the position required in the boxes, for the purpose above set forth.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the arrangement of the horizontal parallel tubes and slides, and the manner of dividing the bees by means of the breath, as set forth.”

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11. For an improvement in the *Cotton Whipper*; Fones McCarthy, Demopolis, Marengo county, Alabama, February 12.

The cotton to be operated on is put on an endless belt of slats, and thus introduced to the action of rotary beaters which act on the cotton against the edges of the slats that compose the endless belt.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the combination of the revolving whipper with the endless conveyor, arranged and operated in the manner and for the purpose set forth.”

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12. For improvements in the *Plough*; Seth J. Roberts, Jeffersonville, Montgomery county, Pennsylvania, February 12.

The land side or cutter is made with a recess to receive a bit called the “stubble bit,” for cutting stubble.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the combination of the stubble bit with the land side casting, in the manner and for the purpose set forth.”

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13. For improvements in the *Machine for cutting Files*; Solomon Whipple, Albany, New York, February 12.

The claims in this patent are numerous and wholly dependent on the drawings, which being too complex and numerous to admit of insertion, we are under the necessity of passing them over.

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14. For an improvement in the mode of *making Pantaloon Buttons*; John Hatch, Attleborough, Massachusetts, February 20.

The following claim fully expresses the nature of this improvement.

Claim.—“I do not claim the making of what is termed the pantaloon button in two pieces of metallic plate, held together by the edge of one being turned over upon that of the other, nor do I claim the combination of two plates (so applied to each other,) with a circular or other proper shaped piece of wood, or cloth, or woven material interposed between them; neither do I claim the combination of a plate of metal and a circular disk of wood together, the former being confined to the latter by its edges being lapped over and pressed down

upon those of the latter : but what I do claim, is my improvement in the modes usually adopted for forming or making the eyelet holes or thread passages of buttons composed of two circular plates of metal, the one of said pieces being confined to the other as above described; the said improvement consisting in punching holes through the plates, (so as to leave a bur projecting on one side of the plate from each hole) before they are applied and connected to each other, and (in combination with) applying the said holes of one plate to those of the other, in such manner that their burred projecting edges may be in direct contact, and the countersunk portion of each of the holes of the plate (there being the same number of holes in each plate) be opposite to that of the corresponding hole of the other plate, thereby forming eyelets or passages countersunk on *both sides of the button*; by which mode of constructing the above, wear of the threads which secure the button when sewed to cloth or other material, is to a very great degree obviated—the whole being substantially as above described.”

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15. For an improvement in the tool called the *Shoemaker's Shoulder Iron, for setting and polishing the edge or forepart of the Soles*; James W. Newberry, Kensington, Philadelphia county, Pennsylvania, February 12.

In the instruments or tools now used for this purpose, the bevel edge, which is used to polish the edge of the sole, is permanently connected with the shoulder which determines the thickness of the sole, and therefore one instrument is required for each thickness. This patent is granted for connecting the bevel edge with the shoulder by a slide regulated by a screw, so as to adapt one instrument to any thickness of soles. The claim is limited to the combination of the bevel edge and shoulder, in the manner described, the distance between the two being regulated by a screw or other analogous device.

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16. For improvements in *Printing Presses*; J. C. Kneeland, Troy, Rensselaer county, New York, February 20.

The patentee says—“In my press as represented in the drawings accompanying the specification, I place the form vertically; but it may, if preferred, be placed horizontally, by arranging the toggle joint and the other parts concerned in giving the impression in such manner as to operate in that position, my improvement not relating to that part of the apparatus by which the platen, the frisket, the inking apparatus and their immediate appendages are operated, or in which they are arranged, these being similar to such as are well known, but consisting, principally, in a novel arrangement of the apparatus for gripping the sheet which is placed on the feeding board; and for carrying it into the proper position for, and holding it whilst it is, receiving the impression.”

We are under the necessity of omitting the claim, as it refers to, and is wholly dependent on, the drawings; but the foregoing extract from the specification fully indicates the nature of the improvement patented.

17. For an improvement in the *Plough*; E. Ball, Greentown, Stark county, Ohio, February 20.

The self-sharpening point of this plough is made reversible and double so that it can be turned over and end for end. It is received in a recess in the land side, and the lower end of the coulter is also received in a recess in the land side and the reversible point, and the three are secured together by means of two bolts passing through them all.

Claim.—“What I claim as my invention, and desire to secure by letters patent is, the manner in which I have combined the coulter, the landside, and the self-sharpening point, so that the three may be secured together by two bolts, giving at the same time great strength to these as herein above described.”

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18. For improvements in *Cooking Stoves*; Robert Wilson, Williamsport, Lycoming county, Pennsylvania, February 20.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is

“1st. The combination of a set of flues and dampers, as above described, between two horizontal plates, for the purpose of drawing the flame and heated air around and about the boilers or kettles, as herein set forth, by which I admit the flame and heated air through the lower horizontal plate into the flues above named at one side or portion of the boiler apertures, thereby obliging the draught first to cross the bottom of the boilers or kettles and then through the apertures in the horizontal plate, thence around the boilers or kettles through the flues to the pipe.

“2nd. I claim the combination and arrangement of the cylinder (S, T,) for burning coal with the plates (C and D,) in the manner and for the purpose described.”

The cylinder S, T, referred to in the claim, has a grate at bottom for coal, and apertures near the top which open into a space between two plates C and D, to conduct the draught to the chimney and cause it to circulate around the kettles.

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19. For an improvement in the *Straw Cutter*; D. M. Seckler, of Wooster, Wayne county, Ohio, February 20.

This is for a method of regulating the feed of a straw cutter, by having the hand or “click” which acts on a ratchet wheel on the arbor of the feed rollers, operated on by pins on the gate which act on the feed hand, or “click,” at each upward motion of the gate.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the arrangement of the lever with its click and ratchet wheel in combination with the pins or studs upon the cutter gate, by which I regulate the length of the feed, and at the same time insure the operation of the pins upon the click; all of which being arranged, constructed, and operated, as herein above described.”

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20. For an improved mode of *Preventing the Explosion of Steam*

*Boilers*; Cadwallader Evans, Pittsburgh, Pennsylvania, February 24.

The patentee says—"The nature of my invention consists in the application of the difference in the expansion of two metals or the expansion of a metal so applied as to cause a safety valve to open, to regulate the supply of water in the boilers, to give notice of the fall or scarcity of water, to regulate a damper, to extinguish the fire by letting water spout on it, and to show the relative temperature of the steam or boiler; all of which can be performed by the same machine respectively, and at the time required, or each can be applied separately.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the difference in the expansion of two metals or the expansion of a metal, as a means of preventing explosions of steam boilers, in the manner described, or any analogous means producing the same result or effect."

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21. For an improvement in the *Hot Blast Bloomery Forge Fire*; Paul A. Sabbaton, Reading, Berks county, Pennsylvania, February 24.

On each side of the fire place there is a large horizontal tube, one to receive the blast of air from the blower, and the other connected with the tuyers, and these two pipes are connected together for the passage of the air by means of bent tubes in the form of an inverted U, and placed immediately over the fire to have the flame impinge on them.

Claim.—"I do not make any claim to the applying of the hot blast thereto; nor do I make any claim to the form or combination of the pipes for heating the air, this being the same with numerous others which have been long known and used; but what I do claim as my invention and desire to secure by letters patent, is the manner in which I have combined said pipes with the bloomery forge fire, by placing them within the chimney immediately over said fire; which chimney is formed in the manner herein described and represented, so as to effect the desired object, without the use of an arch, or of any analogous structure. To this particular combination and arrangement, I limit my claim."

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22. For an improvement in the mode of *Preventing the Explosion of Steam Boilers*; Wm. M. Wright, Pittsburgh, Pennsylvania, February 24.

The following claim gives a sufficiently clear notion of these improvements.

Claim.—"1st. What I claim as my invention is the modes of liberating and reclosing the valves, in combination with the expansion tube and rod, the rod being hermetically attached to the inner end of the tube, by which arrangement a stuffing box for establishing the connexion between the inside and outside of the boiler is dispensed with as described. 2nd. What I also claim is so connecting the safety

valves with the expansion rod as to reclose the valve by the contraction of the metal after a given quantity of steam has blown off, as herein described.

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23. For a mode of *Reducing Grain by Pounding* ; Fones McCarthy, Demopolis, Marengo county, Alabama, February 24.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the construction of the bed in which the grain is ground, and through which it is discharged when ground to the degree of fineness required—that is to say, constructing the centre of the bed with a longitudinal semi-circular or other concave depression in combination with the sides, flaring outward and upward, forming the inclined planes which are perforated with apertures of the size to which the grain is to be reduced and through which the same is discharged when thus reduced; said inclined sides serving also the purpose of conductors of the grain to the bed, and as guards to prevent its escape therefrom, in combination with the pounders, as herein described.”

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24. For an improvement in *Temples for Power Looms* ; Erastus B. Bigelow, Boston, Massachusetts, February 24.

In this temple the upper jaw is attached to one end, and the lever by which it is worked to the other end of a rod jointed to a long bar, which is in turn jointed to the breast beam of the loom, so that the lay shall strike the lever that opens the jaw at a considerable distance from the jaw.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is having the movable jaw at one end, and the lever by which it is operated, at the other end of the rod, and near to the joint which connects the bar to the beam, in combination with the long bar jointed to the breast beam, so as to act when there is little or no motion, by which the operation is rendered more effective and the free action unimpeded and more certain.”

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25. For an improvement in the *Speeder Flyer* ; Erastus B. Bigelow, Boston, Massachusetts, February 22.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is extending the shaft of the presser down from the pressing arm, to the bottom of the flyer, and providing the lower end thereof with an arm, which, in combination with the spring attached to the flyer, enables the attendant to throw back the presser, which is there retained, till the spool is doffed and replaced by an empty one, as herein described.”

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26. For an improvement in the machine for *Filing Saws* ; Jacob Arndt, Wheeling, Virginia, February 24.

The file is secured to a frame which slides lengthwise and vertically on a bar that swivels in the end of a jaw in which the saw is clamped,

and there is a spring that bears up the file frame against the teeth of the saw.

Claim.—“What I claim as my invention, is the combination of the grooved block, which embraces the saw with the bar joined thereto in the middle, and the file frame which slides vertically and horizontally on the bar; the said file frame being provided with a spring to bear the file on the saw, as described.”

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27. For an improvement in the *Propelling Power of Clocks*; Joseph Joes, Bristol, Hartford county, Connecticut, February 24.

This improvement is for so connecting a spring with the barrel of a clock by means of bent levers, as to increase the leverage in the ratio of the decrease of the tension of the spring as it runs down, and thus keep up an equal power.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the mode of equalizing the tension of the cord or chain of the barrel by the combination of the lever, link, and spring, whether constructed and arranged precisely in the manner described, or in any other mode substantially the same.

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28. For an improvement in *Cast-Iron Pipe Boxes for Carriage Wheels*; John Huntington, Zanesville, Muskingum county, Ohio, February 24.

The object of this improvement is to cast pipe boxes with a chilled surface by means of a metallic core made in sections that it may be removed from the inside of the box, and admit of the contraction of the metal in cooling.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the mode or manner of casting pipe boxes for carriage or other wheels, by the use of the segment core, constructed and arranged and used in the way described for chilling or hardening and finishing the interior surfaces of the boxes.

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29. For an improvement in the *Press for Cotton and other substances*; P. G. Gardiner, New York city, New York, February 28.

The follower of this press is operated by two toggle joints that are drawn together by a right and left hand screw driven by a belt from some first mover passing around a pulley on the screw, which turns in boxes that slide in guides, so that they can move freely up and down as the toggle joints are operated.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the combination of the guide carriages or indicators on each side of the pulley, with the *screw and lever power press* to prevent the lateral motion while it allows a free vertical action, all as above described.”

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30. For an improvement in the *Puppet Valves of Steam Engines*; Samuel Talbot, Richmond, Virginia, February 28.

The patentee says—“The nature of my invention consists in pro-

viding and arranging in the centre of the main steam valves a small valve to be opened sufficiently in advance of the main valve, to allow the steam to fill the vacuum between the piston and head of cylinder, and thereby produce an equilibrium of pressure upon the top and bottom of the same, before the lifting rod acts upon it, thereby allowing it to be raised by an amount of power sufficient to raise the weight of the same.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the use of the small valves, operating in the centre of the main valves and by the same motions, substantially as above described; by which arrangement much of the power required to open the valves in the old way, is saved for the direct action of the engine.”

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31. For a *Relief Spring for Ships' Cables, and other purposes in which it is required to overcome the momentum of heavy masses*; Levi Bissel, Brooklyn, New York, February 28.

The cable or other thing to be relieved from a sudden jar, is connected with a wedge which slides between two rollers, one of them being connected with the piston of a pneumatic spring, so that the wedge cannot slide without overcoming the pressure applied to the surface of the wedge by the spring.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the combination of the inclined plane, rollers, and spring, in the manner above described, for any of the above mentioned, or for any other purpose to which the same may be applicable.”

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32. For an improvement in *Pumps*; Joseph H. Webster, St. Louis, Missouri, February 28.

This is for combining the double acting piston of section and force pumps with a slide valve provided with eduction and induction passages adapted thereto.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the double acting suction and force pump with one valve, constructed and operating substantially in the manner and for the purpose herein set forth.”

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33. For improvements in machinery for making *Ropes of any length*; Edward S. Townsend, Palmyra, Wayne county, New York, February 28.

This patent is granted for improvements on a machine patented by Townsend and Durfee, on the 6th of January, 1831, noticed at page 315, of vol. vii of this Journal, second series, to which the reader is referred for a general description.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the combination of the spindle, the end of which is adapted to the reception of the strand for forming, with the sliding block or guide for winding on after the strand is formed as described, also the combination of the spindle, in the machine for laying the

rope, the end of which is adapted for receiving the rope while giving the after turn, with the sliding block for winding on the rope after it is laid, as described. This invention differs from Townsend and Durfree's reel, patented in 1830 or 1831 in the following particulars:—In the use of that reel it was necessary when a single length of the walk, or building, was spun in yarns, to lay the same into rope and reel the same before spinning a second length. In spinning a second length the threads or yarns were united to the several threads or yarns already finished, by splicing or spinning into them, and so a second part of the rope was made and reeled as before. By this process being repeated, the rope was made of the desired length, but could not be made *patent formed* without lacing or splicing in the strands of the threads or yarns."

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34. For an improvement in the machine for *Cutting Sausage Meat*; George A. Coffinan, New Middlebrook, Augusta county, Virginia, February 28.

In this machine the operating cutters are arranged on a rotary shaft or cylinder and the cutters against which they act, project from an adjustable roller so that they can be set relatively to those on the cylinder by means of screws.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the adjustable vibrating roller of inclined blades with the revolving cylinder of cutters, arranged and operated in the manner set forth."

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35. For an improvement in the *Hemp Brake*; H. G. Gardiner, New York city, New York, February 28.

The patentee says—"The nature of my invention consists in combining with a hemp brake, formed similar to the common hand brake, a shaft having two or more series of cams thereon, and giving to said shaft a lateral motion at pleasure, so as to bring either of the cams into operation.

The object of this is to regulate the strength of the blow to suit the condition of the hemp, by sliding the cams or tappets.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of a shaft, having two or more series of cams thereon, with a common hemp brake, such as is used by hand, said shaft having a lateral motion, so as to bring either of the said cams into action at will, the whole being constructed and arranged as herein set forth."

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*Improvements added to previously granted patents during the month of February, 1845.*

1. For an improvement in the *Rake*; H. Haynes, Middletown, Vt., added to letters patent granted to him June 18, 1839; Feb. 12, 1845.

For a description of the original invention, the reader is referred to page 36, vol. xxvi, second series of this Journal.

Claim.—“What I claim as my invention, and desire to have added to my letters patent, is constructing the rake with an additional head, placed in front of, and parallel to, the rear head, into which the ends of the wire teeth are secured, (as described in my former patent,) and coiling the pieces of wire of which the teeth are composed around the said additional head, and extending them down in front of the head in the form of a *cruia-reversa*, or modern scroll, forming the requisite elastic, curved teeth for raking the hay, as described.”

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*Patent Re-issued for amendment in the month of February, 1845.*

1. For improvements in the *Construction and Heating of Furnaces*; C. E. Detmold, New York city, New York, February 20.

This patent was granted on the 15th of July, 1843, and has not yet been reached in our list of arrears; but as a full account of this invention has been published at large in this Journal, by Mr. Detmold, we will simply insert the amended claims, on which the letters patent were re-issued.

Claim.—“I wish it to be understood, that I do not claim as my invention the employing of carbonic oxide gas in combination with heated atmospheric air, this being known as the invention of Wm. Von Faber du Faur, upon which this is intended as an improvement, but what I do claim as my invention is:

The combination of a reverberatory furnace having a deep fire chamber for the special purpose of generating combustible gases from any kind of fuel, as above described, with an arrangement of blow-pipes or other convenient apparatus through which continuous jets of highly heated atmospheric air are forced into the combustible gases in their passage over the fire-bridge, for the purpose of producing their perfect and rapid combustion, substantially as set forth in the above specification.”

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*List of American Patents which issued in the month of January, 1842, with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For improvements in *Lamps*; Edwin B. Horn, Boston, Massachusetts, January 8.

The character or principle of the improvements secured by this patent is fully expressed in the following

Claim.—“I shall claim surrounding the wick chamber by the outer tube or casing which intervenes between it and the reservoir, said tube or casing being constructed so much larger in its interior diameter than the external diameter of the outer tube of the wick chamber, as to form a space between the two through which the air descends and passes into the inner tube of the burner to act upon the interior surface of the flame. Also, bending the button rod under the wick chamber, and continuing it upwards between the same and the external casing or tube, and combining said button rod, so arranged,

with a crank upon the end of a small horizontal arbor, the same being for the purpose of elevating and depressing said rod and button, the whole of the above parts being constructed and arranged substantially as herein above set forth."

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2. For improvements in *Window Blinds*; Garner Wilkinson, White Creek, Washington county, New York, January 8.

The slats of these blinds slide on two rods permanently secured to the top and bottom of the window frame, and their ends are connected together by joint links and intermediate rods, forming chains at the sides of the blinds, to permit the slats to come close together when the blinds are drawn up by a cord that passes from the top through a hole in the middle of each slat, and attached to a hook at the bottom, by which the whole is secured to the sill of the window.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the method above described of connecting the slats together by means of links and intermediate rods, so as to enable them to approach each other in drawing them up; and in combination with the above, I claim the method of fastening them by means of the hook attached to the lower slat and to the cords by which they are drawn up, all as herein above described."

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2. For an improvement in *Fastenings for Bedsteads*; James Knipe, New York, January 8.

The rails are fastened to the posts by screws and nuts, in the usual manner, but instead of the head on the screws, a washer and wedge pin are used, to facilitate the taking down and putting up of bedsteads.

The head-board is secured by letting the lower rail thereof rest in metallic sockets screwed into the post, and having thumb bolts on the upper rail that fasten against metal plates screwed into the posts.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of securing the posts and rails of bedsteads by means of the screw and nut in combination with the washer and pin, in the manner described. I also claim the mode of securing the head-board by means of the socket in combination with the plate and flush bolts, substantially as herein described."

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4. For improvements in *Reverberatory Furnaces*; Claude S. Quillard, Roudout, Ulster county, New York, January 8.

From the fire chamber of the reverberatory furnace, vertical flues are formed, through which the coal is fed, and in which it is prepared for combustion; between the two vertical feeders there is another flue, made pretty much in the form of an inverted funnel, for the purpose of supplying a portion of finely screened anthracite, to be dropped directly upon the burning coal, and which, spreading over its surface, will produce an immediate "blaze, or flashing up."

In front of the fire-chamber there are two ranges of flues furnished with registers, for regulating the supply of air. And for the purpose of removing the cinders, a set of pokeres or a temporary grate is intro-

duced through the air flues, to support the charge of coal whilst the gr̄ate is removed to drop the ashes, cinders, &c.

Claim.—“I am aware that vertical feeders, in which the fuel to be burnt is brought into a state of ignition before it reaches the point where it is to undergo combustion, have been used for various purposes, and I do not, therefore, claim them as of my invention; but such feeders as those constructed by me, and herein described, have not been heretofore used in combination with a reverberatory furnace, or indeed with a furnace of any kind. I do claim, therefore, as of my invention, and desire to secure by letters patent, the constructing of a reverberatory furnace in which anthracite is to be used as fuel with vertical feeders, constructed with feeding and with a flashing flue, and arranged and combined with such a furnace, in the manner herein set forth. Secondly, I claim the combining with such a furnace, the draught holes furnished with registers or sliding plates, as described, and leading directly to the body of the burning fuel in that part thereof where the most intense heat is required. Thirdly, I claim the manner of clearing out the ashes, cinders, and other refuse matters by the aid of the forked or temporary grate bars inserted through the holes, in the manner and for the purpose herein described.”

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5. For an improvement in *Spikes, Nails, &c.*; Wm. T. Steiger, Washington City, District of Columbia, January 8.

The nature of this improvement is fully expressed in the following Claim.—“What I claim as my invention and desire to secure by letters patent, is the screw form given to the angles of the body of the spikes, bolts, nails, &c., by twisting them in the manner herein described, or by any other means producing substantially the same results.”

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6. For an improvement in the mode of *operating the Valves or Dampers of Fire-places or Grates*; Henry Batchelder, Beverly, Essex county, Massachusetts, January 8.

The damper or valve is hinged to the back of the fire-place and closes on to an inclined seat. To the lower face of this damper is jointed a link, which, in turn, is jointed to a nut that travels on a screw turning in appropriate bearings and provided with a key or crank handle, in front of the fire-place, so that by turning this screw, the damper can be moved to any angle desired, and there retained.

Claim.—“I claim operating or regulating an adjustable valve plate in the flue of a fire-place or grate, by means of an arm attached to the plate and a movable nut, said nut being moved forward and back on, and by means of, a revolving screw passing through the same, the whole being substantially as above specified, for preventing chimneys from smoking.”

- 
7. For an improvement in the *Machine for working Butter*; Seth Bishop, Reading, Fairfield county, Connecticut, January 8.

A round tub is hung on a vertical shaft, so that it can be turned by

a pinion taking into cogs on its edge, and on the shaft of this pinion there is a wheel with beaters to act on the butter as it is carried around by the rotation of the tub. A "regulator," or paddle, is jointed to the machine, by which the butter is forced or directed against the beaters.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combining of a movable tub with a revolving beating wheel, together with a regulator for forcing the butter under the beating wheel, as herein described; the whole being constructed and operating in the manner specified."

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8. For an improvement in the art of *Casting Statues*; Lawrence Myers, Philadelphia, Pennsylvania, January 8.

The patentee says:—"My invention consists in making a model or pattern of wax, exactly corresponding with the object required to be cast, which I cover all over with a liquid blacking, composed of 1 pint of pulverized charcoal, 1 gill of rye flour, 1 gill of molasses, 1 gill of sour beer, which are to be well mixed together and then diluted with sufficient water to make it a rich liquid blacking, to be applied to the model or pattern several times, as the weight of the casting may require. While the blacking thus put on is moist I apply my facing sand to the model or pattern, thereby causing the sand to adhere more firmly to the blacking."

Claim.—"Having, since my invention of the wax model or pattern, as before described, been informed that a model or pattern of wax has been used in foreign countries, I claim only as my invention and desire to secure, at this time, by letters patent, the mode of preventing oxidation of the surface of the metallic casting, and obtaining a finer and smoother surface, and deliveration of the figure by means of the aforesaid compound, or any other substantially the same, applied to the wax model, in the manner set forth."

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9. For improvements in the *Machine for Cleaning Grain*; Geo. D. Waldo, Lockport, Niagara county, January 17.

The following claim so fully expresses the nature of the improvement patented, that explanatory remarks would be superfluous.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner of arranging the several tiers of vanes or heaters, one above another, in a vertical case, made in the form of the frustrum of a cone, so that the respective tiers shall increase in diameter in the descending series; and with the vanes of each successive tier in descending, breaking joints with, or standing behind the vanes in the tier above it; and this arrangement of the vanes I claim only as being combined in a machine in which the grain is fed in at the top and is discharged at the bottom, and which is otherwise formed and arranged as herein set forth. I also claim, in combination therewith, the employing of the wire gauze cap, for admitting the air and for preventing the grain from passing the opening in the middle of the bottom of the machine. I do not claim the giving an inclination to the vanes for the purpose of beating the grain upwards and thereby

retarding its descent, as in very rapid motions this would not be necessary, and when it is resorted to, such inclination is but slight; a little device has also been previously resorted to in some of the long vanes or beaters which have been employed in smut machines, their upper ends having been so inclined backwards."

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10. For improvements in *Furnaces for the Smelting of Metals*; Frederick C. Kropff, Philadelphia, Pennsylvania, January 17.

The nature of this invention is fully pointed out in the accompanying

Claim.—"What I claim therein as new and desire to secure by letters patent, is the manner of constructing a gas receiver near the top or tunnel head of a smelting furnace, by combining therewith a cylinder, around which a space is left constituting the said gas receiver, and from which the combustible gases disengaged from the fuel in the furnace are to be conveyed by a tube, or conduit, to undergo combustion where it may be required, the respective parts being arranged and combined substantially in the manner, and applied to the purpose, herein made known. I also claim the manner of constructing and arranging the cast-iron apparatus denominated the gas mixing apparatus, for duly mixing and combining the combustible gases with atmospheric air, such apparatus being combined with a steam engine furnace and boiler, or with whatever else it may be desired to heat, substantially as described. I do not claim the merely mixing or combining of the combustible gases with atmospheric air for the purpose of producing combustion, this being an operation well understood and frequently practised; but I limit my claim in this particular to the manner in which I have effected the object in the apparatus, or in one substantially the same. I also claim as a modification of the same operation and apparatus, the manner of employing the combustible gases for the heating of air for producing the hot blast, or for any analogous purpose, by means of such apparatus connected and combined with the gas receiver, constructed as herein described."

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11. For a machine for *Hulling and Cleaning Clover-seed*; Peter Cook, Westfield, Chautauque county, New York, January 17.

This machine consists of two parallel cylinders of unequal diameters, whose surfaces are provided with points; one of them works in a concave below it, and the other in one above it, and extending under it. The clover seed is fed to the first cylinder, and from this it passes to the second, and is discharged therefrom, at the bottom, on to a shoe provided with several screens, and as the seeds pass through these screens, the chaff is blown away by a rotary fan blower.

Claim.—"What I claim as my improvement and invention and desire to secure by letters patent is the combining of two hulling cylinders, the concaves of which are arranged as set forth, (viz. under one cylinder, and above and partly surrounding the second cylinder) with a fan and shoe containing one or more screens, in the manner set

forth, said cylinders being placed in a horizontal position over the shoe, and constructed of unequal diameters, as described."

12. For an improvement in the *Caps of Lamps*; Francis Draper, East Cambridge, Middlesex county, Massachusetts, January 17.

The lamp cap which we have here is made with a collar to fit inside of the neck of the lamp and to extend below it, so that when the lamp is tilted the oil shall not reach and pass through the screw, &c. of the wick tube.

Claim.—"I claim as my invention, the internal tube or collar applied to the cap of a lamp and extending downwards through the neck of the oil chamber, the same being constructed substantially in the manner and for the purpose herein above set forth."

## ENGLISH PATENTS.

*Specification of the Patent granted to JAMES GRAHAM, of the county of Middlesex, for improvements in the manufacture of Zinc, Antimony, and Brass, in casting brass, and in apparatus for making pots used in such processes.*—Sealed February 17, 1845.

These improvements relate, firstly, to applying certain apparatus to effect more advantageously the condensation of the zinc.

Secondly, to a certain arrangement in the construction of part of the pipe through which the distillation of the zinc is carried on, so that a considerable saving of labor is effected, and likewise the chance of loss from the negligence of the workmen in performing such labor is avoided.

Thirdly, to a certain method of tapping pots containing molten zinc, antimony and brass, whereby the zinc is obtained with greater purity than by the method usually adopted; and a considerable saving in fuel results in the melting of the metals; and

Fourthly, my invention relates to an apparatus for ramming the material when making pots used for the purposes above-mentioned. And in order that my invention may be fully understood and readily carried into effect, I will proceed to describe the means pursued by me.

The first part of my invention I perform in the following manner: The lower ends of the descending pipes from the pots used in the manufacture of zinc are to be placed four to six inches under water and a suitable outlet for the gas or gases is to be formed, by which means the zinc is condensed more effectually. The immersion of the tube in water would, if alone resorted to, leave no exit for the gases generated, and consequently there would be such a pressure on the pots as would either burst or break them, or blow the water out of the ends of the pipes and vessels; to avoid this, I insert in the said pipe between the surface of the water and the underside of the brickwork of the furnace described in the specification of my former patent here-

inafter referred to, a gas burner, with a cock, through which the gas or gases are allowed to escape, and I light and thus burn such gas or gases; and they burn with more or less intensity according to the rate of reduction of the metal, thereby serving, not only as a criterion of the progress of the operation, but also as a means of saving and condensing the fine metal. By these means air will be prevented from coming in contact with the zinc vapor or the zinc in the descending tubes, and at the same time, the pressure being removed, the fine metal is preserved from oxidation and collected in the shape of finely-divided metal, instead of a considerable portion burning away, creating waste, and producing a nuisance. Towards the end of this process I have found that the gas or gases do not come off in sufficient quantities to burn. I then close the cock of the burner, and remove a quantity of the water from the vessel into which the descending pipes enter so as only just to seal the ends of the pipes with water, and in order to prevent a vacuum, or partial vacuum, in the pots should the fire get low, or otherwise, I apply a light valve in the side of the descending pipe, opening inwards.

The second part of my invention I effect as follows:—In the manufacture of zinc I have for some time employed a lining of clay or earthen material to the upper part of the descending tubes, as is described in the specification of letters patent bearing date at Westminster, the 18th day of October, A. D. 1843, and granted to me for improvements in the construction of pots and furnaces used in the manufacture of zinc, and in other manufactures, and also improvements in the treatment of ores of zinc, in the process of manufacturing zinc, instead of the lining which was attached or fixed at the upper part of the descending tubes. I place in the descending tubes a movable clay pipe in order to line the same, by which the frequent labor of cleaning or scraping the descending metal tubes is dispensed with, it being only necessary to clean the movable clay pipe once or twice during the operation, and when the charge is exhausted the said movable clay pipe may be cleaned, or if not readily cleaned it may be broken, in order to separate the metallic zinc which will, to some extent, be found adhering to this inner movable clay pipe. The movable clay pipe I fix, by small clamps, at or near the bottom of the descending tube, or by any other appropriate means, allowing of the ready removal of such linings; and I would state in respect to this part of my invention that it is not new to line the descending tubes with clay pipes, I having, in my former specification, described the use of fixed clay lining, but I have since found in practice that it is desirable to have them readily removable.

The manner of performing the third part of my invention consists in using pots or crucibles (placed in a furnace somewhat similarly constructed to the one described in the specification of my former patent) of the capacity desired, having each a hole on one side, close to the bottom, into the pots or crucibles, such holes being closed with clay. When the granulated zinc, antimony, or brass above-mentioned is charged into these pots I close the top with a clay cover, which may be luted on or not. When the metal is melted it is to be tapped by

means of a drill, cutting away the clay at the holes, and the charge, or any part thereof may be run out into ingots, or cast, or otherwise, observing only with respect to zinc, that after the charge is ran out that which is left in the pot or crucible is to be stirred well round and round with a stick, or piece of wood, by which means the metal contained in the remaining portion will be liberated, and nothing will be left but oxide, which had better be removed before a fresh charge is put in. And it should be stated, that during the stirring, the hole is to be closed with clay, which is to be removed in order to run off the zinc which will have descended to the bottom of the pot or crucible. This furnace, as above stated, is to be constructed similar to those described in my former patent for making zinc; but in this instance there will be no pipes or tubes to the pots, but they will be heated and otherwise arranged like that furnace, leaving holes through the furnace for tapping the holes in the pot, which holes in the furnace will be closed with bricks till the tapping is to be performed.

In making antimony I charge the pots with crude antimony, or the ore free from stones, as is well understood in charging movable crucibles, and when the charge is done the pots are to be tapped by a drill, as explained.

In my said former specification I described a means of making pots, and pointed out how the material, of which the pots were composed, was to be rammed, since which I have materially lessened the labor of ramming, by having a cylindrical rammer large enough to fit the interior space where the plastic materials are introduced between the staves or parts of the mould and the core, such cylinder being, however, capable of rising freely up and down within such space, and the lower edge of the cylindrical rammer is made rough, or is formed with projecting teeth to penetrate the clay. The rammer is made of metal, and is raised by means of a rope passing over a pulley, and the rope descends to a treadle, by which a workman may raise the rammer and let it descend quickly; by this arrangement the work will be more uniformly rammed, and be performed at less cost.

And now having described my said improvements, I would wish it to be understood that what I claim as my invention is,

Firstly, the improvement in the manufacture of zinc, by allowing the escape from an outlet, as above described, of the gas or gases generated during the process of reducing zinc, the descending pipe being sealed or closed by immersion in water, and contact of the atmospheric air with zinc or zinc vapors being prevented.

Secondly, the improvement in the manufacture of zinc, by lining the descending pipe or tube with a movable clay pipe, for the purpose of avoiding the frequent cleaning of the descending pipe or tube.

Thirdly, the melting of zinc, antimony, and brass in pots or crucibles, provided with holes close to the bottoms, as hereinbefore described, and by tapping such pots by means of a drill or otherwise.

Fourthly, the using of a cylindrical rammer and apparatus, as herein described, when making pots for the purposes above-mentioned.—  
[Inrolled August 17, 1845.]

*Specification of the Patent granted to DAVID METCALF, of Leeds, in the County of York, for a Mode of Manufacturing or Preparing a New Vegetable Preparation applicable to Dying Blue and other Colors*—Sealed November 21, 1844.

My invention of a mode of manufacturing or preparing a new vegetable preparation applicable to dying blue and other colors, consists in subjecting the leaves of a certain plant hereafter to be described to the same process of manufacture or preparation as has been heretofore applied to the leaves of the woad plant in order to fit them for the dyer's use. The plant thus to be substituted for woad is that which is sometimes called "succory," but is more commonly known in commerce by the name of "chicory." In order to obtain the said new vegetable preparation applicable to dying blue and other colors, I manufacture or prepare the leaves of the chicory plant in manner following:—

I first grind or crush them in a mill just such as is ordinarily employed in the preparation of woad. I then form the granulated mass into balls, which, when sufficiently dried, are broken into small pieces and subjected to the fermenting process called couching, after which the article is ready for the dyer. In some cases the leaves of the chicory plant are sufficiently dry after the first grinding to be subjected at once to the couching process; in such cases I proceed without the delay occasioned by the preparatory drying. In this way I obtain a new vegetable preparation applicable to the dying of blue, and of all other colors to which woad is applicable. I would here remark that I have not found it necessary to set forth any more in detail the precise nature of the apparatus and process used in the manufacture or preparation of the leaves of the chicory plant, because I employ the same apparatus, and subject them to the same process as are well known in the manufacture or preparation of the leaves of the woad plant.

Having thus described the nature of my invention, and the manner in which the same is to be carried into effect, I desire it to be understood that what I claim under the above in part-recited letters patent is the manufacture or preparation of the leaves of the chicory plant in the manner above described, for the purpose of obtaining a new vegetable preparation applicable to the dying of blue and of all other colors to which woad is applicable. [*Inrolled May, 1845.*

Ibid.

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*Important Case of Infringement of Patent:—Newton vs. the Grand Junction Railway Company.*

This was an action to recover compensation from the company for the alleged infringement of a patent taken out by the plaintiff on the 15th of May, 1843, for improvements in the bearings of the axles of railway carriages, and other axles where great friction existed. The

invention purported to have been a communication from a Mr. Isaac Babbitt, an American, from Boston. Mr. Babbitt was in Liverpool in the year 1843, and had permission from the Liverpool and Manchester Railway Company to make experiments on two of the engines on their line. The result was satisfactory, and he afterwards sold the discovery to the present plaintiff.

A great mass of evidence was adduced, to show the nature of the invention, its novelty, and the importance of the results in diminishing the wear and tear of locomotive engines. It appeared that the invention consisted in lining the semi-circular brass "step" of the axle, which rested on the axle, and bore the weight of the carriage, with an alloy of a softer metal, of considerable thickness, which was prevented from spreading and yielding to the pressure by a brass fillet along its edge. The step was lined by first polishing the inside, tinning it, and then placing within it a mould the size of the axle or "journal," as it was called, running in the alloy while in a state of fusion. This alloy in cooling adhered to the tin and became incorporated with the brass step, fitting closely to the journal or axle which revolved in it.

A great number of witnesses were called to prove the advantage of this arrangement, in diminishing friction, in preventing the heating of the axles, in needing a smaller supply of oil, and in enabling the bearing to run for a much longer time without the necessity of renewal or repair.

Mr. Fothergill, foreman to Messrs. Sharp & Co., stated that he had for many years been employed in the manufacture of railway carriages, and that this improvement was new to him until the appearance of the patent in 1843. It was a very great improvement, and extremely useful in diminishing friction and preventing heating.

On cross-examination he stated that he had previous to that time known tin and lead used to repair old brasses when they had ceased to fit from wear, and there was not time to substitute a new one. The lead or tin was run in to make it fit until a new one could be supplied. He had known various bearings of solid block tin used, but they did not answer.

Mr. Robert Stephenson, C. E., gave similar evidence as to the utility of the invention. He said if the inside of the bearing were merely tinned, it would prevent heating, and in that thin coating would not spread by pressure. It would wear out sooner, and the fillet in the plaintiff's invention was useful in enabling them to run in a mass of alloy in a melted state, which coated the step to a considerable thickness without spreading by pressure, as it would do without the fillet.

Mr. John Fairburn, engineer at Manchester, gave similar statements as to the utility and novelty of the invention. He stated that he had known block tin and various alloys used for bearings, but always in a solid block. The novelty was in having an outer case and running in the alloy.

Mr. Thomas Wilkinson, foreman to Messrs. Bolton & Watts, Soho works; Mr. Jones, Clerk to the Liverpool and Manchester Company,

near Newton, and others, were examined. Their evidence was to the same effect.

Mr. Michael Allison, out-door foreman of the locomotive department to the Liverpool and Manchester Railway Company, stated, that there had been a very great and marked improvement in the running of the engines since the introduction of this invention. The Kingfisher, the Heron, and the Ostrich were fitted up with these bearings. Formerly the brass bearings on the old construction would run from 400 to 1,000 miles. They would run, when fitted up pursuant to the patent, from 4,000 to 10,000. The Kingfisher had run 20,000, and the bearings were still in good condition. A bearing now produced had run 32,000 miles without repairs.

Mr. Benjamin Lewis; Mr. Edward M'Connell, engineer to the Birmingham and Gloucester Railway Company; Mr. Benjamin Cubitt; Mr. Fernyhough, manager on the Eastern Counties line; Mr. Melling, engine-maker, at Rainhill, and others, repeated in a great measure what had been said by the other witnesses as to the novelty and the utility of the invention.

Evidence of the infringement of the patent was also adduced. It appeared that in the case of many of the old brass bearings, as well as in new ones, when put in for the first time, the workmen were in the habit of tinning the inside of the brass, heating it and then rubbing a stick of tin on it so as to cause it as much as possible to adhere. This had been pointed out to the directors on several occasions by their managers, and the results in preventing friction, and diminishing the expenditure of oil, were mentioned. A long correspondence between the plaintiff and the secretary of the company was put in and read, the plaintiff claiming compensation for the use of his patent.

In one of these letters the secretary, while he denied that the company was infringing the patent, added, that the use of the tinning, in the way described, was of very little benefit, and that they thought of abandoning it.

Mr. Wortley addressed the jury for the defence, and called a number of persons to show that at Nantwich, Bury, and other places, where the brasses used in cotton mills had become worn, or did not fit, it was very usual to run in a quantity of an alloy of tin.

Mr. Hodge stated, that many years before the existence of this patent, in 1829, he had made a lathe, being then resident in Cornwall, the bearings of which were provided with a fillet and lined with an alloy run in precisely in the manner described in the patent, the object being that which the patent proposed—the diminution of friction. There were then many bearings of the same kind in use in Cornwall. This lathe he afterwards took to London, and sold there. He had not heard of it since, and did not know that this improvement was then generally known. He afterwards made an experiment with a view to improved bearings for the axles of a saw-mill. The improvement was the making of three longitudinal grooves along the surface of the brass bearing, and filling them up with an alloy. Nothing further, however, was done in the matter. The witness afterwards went to America, from which country he had but lately returned.

Mr. Baines replied, commenting strongly on the conduct of the company through their officers, who, he contended, had sought to evade the plaintiff's patent, and to get the benefit of his discovery without paying him that reasonable remuneration to which he was entitled.

His Lordship summed up. He said the question for the jury would be whether the defendants had violated the plaintiff's patent by using the whole or any part of his invention. If a patent is granted for a new combination of things known before, that does not prevent any other party from using that which was old. There was no evidence that the defendants had used the whole of the plaintiff's invention in the steps with the fillets as described in the patent; but it seemed established that their servants took old and new brasses, and after tinning them in the usual way, had while the brasses were hot, with a stick of tin, laid on as much as they could to the extent of from the 16th to the 8th of an inch. Many of the brasses were new, and it was not, therefore, the mere patching of old ones. Was that substantially an adoption of any part of the patent?—had they, by thus laying on the tin, smoothing it in some cases with a soldering-iron, as described, obtained some portion of the benefit of the invention; and was that part new?

The jury, after being out a considerable time, returned a verdict for the plaintiff—Damages, £1000.

Load. Mech. Mag.

## MECHANICS, PHYSICS, AND CHEMISTRY.

*On the different varieties of Sugar, and allied substances, with reference to the practical application of their Optical relations.*  
By VENTZKE.

Translated from Erdman's Journal der Pract. Cheme, vol. xxv, p. 65, by J. C. Booth, and M. H. Boyé, and communicated to the Journal of the Franklin Institute, by Prof. R. S. McCulloch.

Continued from page 268.

### II. *Practical Application to the Sugar manufacture.*

A. PREPARATORY EXAMINATIONS.—Many points have not been expanded in the foregoing, which may have some influence on questions to be solved, such as,

#### 1. *Influence of temperature on polarization.*

The observation was often made, that in cane sugar solutions of 25 per cent. content, a considerable elevation of temperature has no influence on its deviation to the right. Now since a very concentrated solution of cane sugar diminishes considerably in specific gravity by heat, and since the influence of this diminution upon the polarization ought to be apparent, the following experiments were instituted on this subject and confirm the above conclusion.

a. A cane sugar solution of sp. gr. 1.343 at  $17\frac{1}{2}^{\circ}$  C. ( $63\frac{1}{2}$  F.) gave a deviation with normal length of the stratum (= 234 Mm.) of  $174^{\circ}$

to the right. The brass tube fig. 2 is used for this purpose, having an additional tube *d*, for receiving the expanded solution which is heated, say to  $80^{\circ}$ — $85^{\circ}$  C. ( $176^{\circ}$  to  $185^{\circ}$  F.) notwithstanding this increase of temperature, no other deviation is observed as might have been conjectured; for it should be less for the diminished specific gravity.

In order to have a point of comparison, the above solution is heated to  $85^{\circ}$  C. ( $185^{\circ}$  F.) = 1,306. By adding so much water that it has the same density at  $17\frac{1}{2}^{\circ}$  C. ( $63\frac{1}{2}^{\circ}$  F.) and polarizing it in the same tube, it shows  $156^{\circ}$  to the right, or  $18^{\circ}$  less than a solution of 1,343, which had been brought to the density of 1,306, or had lost 0,037.

The tube could not be lengthened by the above temperature, more than 0.5 Mm. corresponding to an increase of deviation of some  $0.3^{\circ}$  which might be included in errors of observation with concentrated solutions.

The next question is how sugar with a deviation to the left would behave under such circumstances.

*b.* Such a solution may be prepared according to Mitscherlich's method by boiling cane sugar with tartaric acid for  $2\frac{1}{2}$  hours, and separating the acid with carbonate of lime. Let the sugar solution have a density of 1.245 at  $18^{\circ}$  C. ( $64.4^{\circ}$  F.) so that it gives in the above tube a deviation of  $49^{\circ}$  to the left. Heated from  $59^{\circ}$  C. to  $63^{\circ}$  C. ( $138.2^{\circ}$  to  $145.4^{\circ}$  F.) the deviation is  $23^{\circ}$ — $24^{\circ}$  to the left, or  $25$ — $26^{\circ}$  less than at  $18^{\circ}$  C. ( $64.4^{\circ}$  F.) The specific gravity of this solution at  $59^{\circ}$  and  $62^{\circ}$  C., is 1,210 and 1,215. When it is diluted so as to show a sp. gr. = 1.212 at  $18\frac{1}{2}^{\circ}$  C. ( $63\frac{1}{2}^{\circ}$  F.) its deviation is  $36.2$  to the left.

*c.* In order to submit a natural fruit sugar to the same process, and to ascertain also what influence is exerted by grape sugar, fruit sugar from honey is mixed with so much grape sugar also from honey that the rotation is still to the left. Let it have a density of 1,083 at  $19^{\circ}$  C. ( $66.2^{\circ}$  F.) and show a deviation of  $-12^{\circ}$ ; and when heated to  $60^{\circ}$  C. ( $140^{\circ}$  F.) of  $-8^{\circ}$ . The liquid at this temperature = 1.07 and when so far diluted as to be 1.07 at  $18^{\circ}$  C. ( $64.4^{\circ}$  F.) the deviation was  $10^{\circ}$  to the left.

The results of these experiments render it probable, that according to *a*, in sugar solutions which polarize to the right, the smaller deviation produced by the diminished specific gravity is neutralized by heat; or in other words, heat is an equivalent for the content in active substance of the observed stratum diminished by expansion. The reverse takes place with sugar having rotation to the left. The influence of temperature is the more apparent, as it adds to the diminution produced by expansion, for

If in <i>b</i> , the expansion was	— $49^{\circ}$
it could only be reduced by mere expansion, to	<u><math>36.2^{\circ}</math></u>

or only	<u><math>12.8^{\circ}</math></u>
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But the real diminution was  $49 - 24 = 25^{\circ}$  so that  $12.2^{\circ}$  remain for heat, or about an equal action to that of expansion, and —  $49 - (12.8 + 12.2) = -24$ .

It would therefore seem as if *heat alone* always produced rotation

towards the *right*, which is in a certain ratio to the diminution of rotation produced by expansion, so that the heat-rotation in circular polarization is *neutralized* towards the right and doubled towards the left. In the latter case it is important in observations, in the former it disappears altogether.

It therefore may be assumed at present for all practical purposes, that with saccharine mixtures which rotate to the right, the temperature during the observation may be wholly disregarded.

But it is different in the determination of the density of sugar solutions. For, in order to obtain results that may be relied upon, we must always have a uniform density as a basis, which is here assumed to be 1,1056 at  $17\frac{1}{2}^{\circ}$  C. ( $63\frac{1}{2}^{\circ}$  F.) (25 percent. sugar content.) The temperature may vary between  $8^{\circ}$  C. and  $28^{\circ}$  C. ( $46\cdot4^{\circ}$  and  $82\cdot4^{\circ}$  F.)

The following table shows what density the normal liquid would have at these temperatures.

TABLE A.

C	F	Density	C	F	Density	C	F	Density
$28^{\circ}$	( $82\cdot4^{\circ}$ )	1.1028	$21^{\circ}$	( $69\cdot8^{\circ}$ )	1.1048	$14^{\circ}$	( $57\cdot2^{\circ}$ )	1.1064
$27^{\circ}$	( $80\cdot6^{\circ}$ )	1.1031	$20^{\circ}$	( $68\cdot0^{\circ}$ )	1.1050	$13^{\circ}$	( $55\cdot4^{\circ}$ )	1.1066
$26^{\circ}$	( $78\cdot8^{\circ}$ )	1.1034	$19^{\circ}$	( $66\cdot2^{\circ}$ )	1.1052	$12^{\circ}$	( $53\cdot6^{\circ}$ )	1.1068
$25^{\circ}$	( $77\cdot0^{\circ}$ )	1.1037	$18^{\circ}$	( $64\cdot4^{\circ}$ )	1.1055	$11^{\circ}$	( $51\cdot8^{\circ}$ )	1.1070
$24^{\circ}$	( $75\cdot2^{\circ}$ )	1.1040	$17^{\circ}$	( $62\cdot6^{\circ}$ )	1.1058	$10^{\circ}$	( $50\cdot0^{\circ}$ )	1.1072
$23^{\circ}$	( $73\cdot4^{\circ}$ )	1.1043	$16^{\circ}$	( $60\cdot8^{\circ}$ )	1.1060	$9^{\circ}$	( $48\cdot2^{\circ}$ )	1.1074
$22^{\circ}$	( $71\cdot6^{\circ}$ )	1.1045	$15^{\circ}$	( $59\cdot0^{\circ}$ )	1.1062	$8^{\circ}$	( $46\cdot4^{\circ}$ )	1.1076

## 2. Determination of Water and insoluble substances in Sugars.

Cane sugar, &c. contain hygroscopic water and insoluble substances partly from sugar cane, partly as accidental impurities. Can such a loss be determined by the hydrometer alone? Many comparative experiments made with very different kinds of raw sugar by determining the loss directly, and by the saccharometer, proved that the saccharometer would give a sufficiently accurate result for the manufacturer.

Thus a very brown crude sugar may give: Water, = 5.52 p. c.  
Insolubles, = 0.33 "

Loss, 5.85 p. c.

The hydrometer indicates 6 per cent. which is probably more accurate than that ascertained directly.

In table B, one part of the testing sugar is supposed to be dissolved in 3 parts water. The table shows what percentage of dry sugar is contained in the test by means of the density and temperature ascertained at the same time.

In table C, 3 parts molasses in 7 water is assumed as the basis. The table gives the content of water in 100 parts of the molasses. It may also be employed, for sugar or molasses which has been concentrated to a certain point, and of which the content of water is required. If it is supposed to be under 14 per cent., it may be dissolved in the proportion as required by table B, and this used.

3. *The percentage of molasses sugar in mixture with cane sugar.*

Where molasses is boiled and the loss replaced by distilled water, it will not produce rotation to the left, even by a 40 hours boiling of a green bastard molasses which has therefore been boiled several times in the refinery. It exhibits no deposit of ulmic matter, nor can the presence of cane sugar be proved by treatment with chlorohydric acid, for the polarization remained = 0.

When still farther boiled, this molasses becomes cloudy with light brown ulmic matter, and exhibits a few degrees rotation to the right. Can it well be doubted, that here, as in many cases adduced by Soubeiran, molasses and fruit sugar (Soubeiran's Chylariose) were changed into grape sugar? A molasses boiled until it begins to rotate to the right will deposit crystals after some months: and when cane sugar is boiled 32 hours with water, so that the latter together with the formic acid produced, may condense and flow back, the whole mass after 4 to 6 weeks will become solid by crystalizing grape sugar mingled with fruit sugar. Mitscherlich confidently asserts that fruit sugar passes into grape sugar by boiling with sulphuric acid.

We must at all events suppose that if the formic acid remains in the liquid, it must exert some influence by contact similar to that of other acids. There is therefore nothing positive against the formation of a peculiar sugar incapable of polarization, which may be termed molasses or syrup sugar, and which according to Mitscherlich's supposition is produced when dry cane sugar is fused at  $160^{\circ}$  C. ( $320^{\circ}$  F.) In this case it would be the product of the influence of heat without water; by boiling, the action of water is superadded without allowing the volatilizing acid to act with free access of air.

It may be assumed for the present, that all sugars and sirups occurring in a refinery for examination must consist mainly of mixtures of cane and molasses sugar, with a few coloring and nitrogenous substances and accidental impurities, and that the proportion of the two former to each other may be determined by polarization.

Another question must be determined whether molasses sugar, to which given percentage proportions of cane sugar have been added, causes the latter to rotate less to the right; and in the same proportions? Experiments made by mixing colorless molasses sugar of the normal density (1.1056) with cane sugar solution of the same density, so that the mass contained 20, 40, 60, and 80 per cent. of the latter, showed the right rotation, coinciding perfectly with the content of cane sugar.

The apparatus is arranged in such a manner that the percentage of cane sugar can be read off directly. As pure cane sugar rotates  $56^{\circ}$ , and sirup sugar = 0, there is fastened on the axis of the prism E' fig. 6, a wheel with 90 teeth, which is fitted to a pinion at the side with 14 teeth; when the latter makes one revolution the prism describes  $56^{\circ}$  of a circle for  $14 : 90 :: 56 : 360$ . A disk L, is fixed on the pinion and divided into 100 degrees. The fixed index at L, points to the percentage of cane sugar corresponding to a certain rotation of the prism.

## B. EXAMPLES OF THE METHOD OF OBSERVATION.

1. *Green Sugar-house molasses or Bastard molasses.*

*a. Weighing.* The vessels for weighing are glass cylinders 10 in. high by 2 in. diameter, ground at top and covered with a ground glass plate, which may be fastened by a clamp and screw, so that the cylinder may be turned in any direction without spilling its contents.

We may determine before-hand, once for all, how far the cylinder would be filled with 100 gm. molasses, and mark it on the glass. The balance with 600 gm. weight should turn with a few mgrm., and the arms of the dishes should be some 15 in. long for convenience in filling.

To determine the quantity of water of the molasses the dried cylinder with its glass plate is weighed.

Suppose it to be	-	-	213.500 gm.
Filled to the mark with molasses it is now in gross			317.575 "

Therefore the nett weight of the molasses is, 104.075 "

According to table C, 7 water is added to 3 molasses 3 : 7 :: 104.075 : 242.841 gm. Water, = 242.841 gm.

The whole weight, therefore, to be laid on the balance is equal to 317.575 + 242.841 = 560.416 gm.

The best method of adding the water is to take about 5 gm. off the weights, then add nearly the quantity of water, and replacing the weights (5 gm.) to add the remainder by a pipette with a fine opening. It is much too inaccurate to add water by measurement.

The glass plate is set on, screwed fast and the cylinder shaken, until every particle of molasses is removed from the sides. The pasty lumps of crude sugar dissolve very slowly.

*b. Determination of Water.*—The hydrometer ranges from 1.0800 to 1.1100 and is so constructed that 0.0005 may be readily read from it, and the intermediate parts be approximately estimated; a Centigrade thermometer from 0° to 40° is also requisite; or Fahrenheit's from 32° to 104°.

When the air bubbles disappear from the solution by rest, the plate is removed and the hydrometer slowly let down into the liquid. It shows 1.0985. The temperature is also 21° C. (69.8° F.)

The table shows for 1.098 at 21° (69.8° F.) 21.7 per cent. water.

"	"	1.099	"	"	20.9	"	"
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Difference, 0.8 per ct.

For a  $\frac{1}{2}$  thousandth therefore 0.4 must be subtracted; or 21.7 — 0.4 = 21.3 per cent. for the content of water.

*c. Determination of the Cane Sugar.*—About 120 gm. of the molasses are dissolved in as much more water, and then decolorised, as above described. When the body is very dark, as in this case, the cylinder for discoloring should be 2 to 3 ft. long, by 1 in. in diameter. The normal density is attained by taking accurately the temperature and observing the density as given in table A, and adding water until the desired density is reached. Let it show a temperature of 22° C. (71.6° F.) then the density according to the table must be 1.1045.

The cylinder is covered with the glass plate to avoid evaporation when the tubes are not immediately filled.

As the hydrometer is frequently plunged into the liquid while reducing it to the standard density, it should each time be laid in water and wiped with a linen rag, as it might otherwise produce errors of several per cent.

The observation tube, fig. 3, of the normal length = 234 Mm. is filled with the prepared molasses solution, and attached to the apparatus, as above described. The comparing liquid of anilate of iron in the tube M, fig. 6, is also directed to the flame, and when at the distance of 4 in. to 6 in. we look through the prism E' and through M, with both eyes, then by turning the former to the right we can accurately produce in the observing tube the coloring of red, which coincides with the constant color in M.

The content of cane sugar may now be read off directly on the pinion disk L, fig. 6. It amounts to 60.75 per cent. of the dry substance. It was ascertained above, that this molasses contained 21.3 per cent. water, and therefore 78.7 of cane and sirup sugar together; 100 parts of dry substance contain as just determined, 60.75 per cent. cane sugar, and 39.25 of molasses sugar. Therefore the 78.7 of the two together

equal 47.81 cane sugar
and 30.89 molasses sugar
with 21.30 water
<hr/> 100.00

### 2. Common Brown Raw Sugar.

In examining every crude sugar, it is very important to get an average of the whole. To determine the content of water and insoluble matters, it is treated in the same way as molasses, only that 3 parts water to 1 sugar, are employed, or about 80 gm. of the latter.

Suppose the exact nett weight to be 78.380

We add of water (78.380)  $\times$  3 = 235.140

Let this solution show a density of 1.098 at 21° C. (69.8° F.) then table B shows at this temperature and density 94 per cent. sugar, so that the raw sugar contains 6 per cent. water and impurities.

In most cases the solution does not clear entirely by standing, little particles of the same spec. grav. as the liquid floating about in it; but these merely augment its volume without altering its density. An accurate result may be attained by letting it stand 24 hours before using the hydrometer.

The content of cane sugar is ascertained as with the molasses. Before decolorizing, the solution must be made perfectly clear, which if it cannot be done by filtration alone, must be effected by some fresh blood or beaten white of egg, for it is essential that the observations be made with a perfectly clear solution, since a trifling opalescence in a liquid of the thickness of 234 Mm. makes white light appear red, preventing the true determination of the proper tone of color.

Let the temperature at which the normal density is taken, be 13° C. (55.4° F.) Then the density according to table A, is 1.106. This liquid subjected to polarization shows

89 per cent. cane sugar	}	dry material.
11 " molasses sugar		

Now the above sugar contains 94 per cent. dry crude sugar, therefore the crude sugar contains 83·66 per cent. cane sugar.

10·34	"	molasses sugar.
6·00	"	water and impurities.

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100·

It may be asked how much molasses and sugar as commercial articles this sugar would yield. If the results of the above bastard molasses be taken, we have the following estimate.

The bastard molasses consisted of 39·25 per cent. molasses sugar.  
and - 60·75 " cane sugar.

The above sugar contains 10·34 per cent. molasses sugar, which would therefore require 16 parts cane sugar to make the commercial molasses: for  $39·25 : 60·75 :: 10·34 : 16·0$ . The proper proportion of molasses and sugar, is therefore obtained by subtracting the 16 per cent. from 83·66 per cent. and adding it to the 10·34, so that the proportion would be

67·66 Sugar	}	dry material.
26·34 molasses		

By adding the 21·3 per cent. water to the calculation for making an ordinary molasses, we have  $78·7 : 21·3 :: 26·34 : 7·13$ ; so that  $26·34 + 7·13 = 33·47 =$  equal the commercial sirup. The above sugar would therefore produce 67·66 per cent. commercial sugar.

33·47	pr. ct.	"	molasses.
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Making 101·13 for every hundred crude sugar.

TABLE B.  
*Per centage of Cane Sugar—Specific Gravity.*

Spec. Gravity	C	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°
F	46.4	43.2	50.0	51.8	53.6	55.4	57.2	59.0	60.8	62.6	64.4	66.2	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	
-1.088	82.0	82.2	82.4	82.6	82.8	83.0	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.5	84.7	85.0	85.2	85.5	85.7	86.0	86.3	86.6
-0.89	83.0	83.2	83.4	83.6	83.8	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4	85.5	85.7	86.0	86.2	86.4	86.6	86.9	87.2	87.5
-0.90	84.0	84.2	84.4	84.6	84.8	85.0	85.2	85.4	85.6	85.8	86.0	86.2	86.4	86.6	86.7	86.9	87.1	87.4	87.6	87.9	88.2	88.5
-0.91	85.0	85.2	85.4	85.6	85.8	86.0	86.1	86.3	86.5	86.7	86.9	87.1	87.3	87.5	87.7	87.8	88.1	88.4	88.6	88.8	89.1	89.4
-0.92	86.0	86.1	86.3	86.5	86.7	86.9	87.1	87.3	87.5	87.7	87.9	88.1	88.3	88.5	88.6	88.8	89.0	89.2	89.5	89.8	90.1	90.4
-0.93	86.9	87.1	87.3	87.5	87.7	87.9	88.0	88.2	88.4	88.6	88.8	89.0	89.2	89.5	89.8	90.0	90.2	90.4	90.7	91.0	91.3	91.6
-0.94	87.9	88.0	88.2	88.4	88.6	88.8	89.0	89.2	89.4	89.6	89.8	90.0	90.2	90.4	90.7	90.9	91.1	91.3	91.6	91.9	92.2	92.5
-0.95	88.8	89.0	89.2	89.4	89.6	89.8	89.9	90.1	90.3	90.5	90.7	90.9	91.1	91.3	91.6	91.8	92.0	92.2	92.5	92.8	93.1	93.4
-0.96	89.8	90.0	90.1	90.3	90.5	90.7	90.8	91.0	91.2	91.4	91.6	91.8	92.0	92.2	92.5	92.7	92.9	93.1	93.3	93.6	93.9	94.2
-0.97	90.7	90.8	91.0	91.1	91.3	91.5	91.6	91.7	91.9	92.1	92.3	92.5	92.7	92.9	93.1	93.3	93.5	93.7	93.9	94.2	94.5	94.8
-0.98	91.6	91.7	91.9	92.1	92.3	92.5	92.6	92.8	92.9	93.1	93.3	93.5	93.7	94.0	94.2	94.4	94.6	94.8	95.1	95.4	95.7	96.0
-0.99	92.5	92.6	92.8	93.0	93.1	93.3	93.4	93.6	93.8	94.0	94.2	94.4	94.6	94.8	95.1	95.3	95.5	95.7	96.0	96.3	96.6	96.9
-1.00	93.3	93.4	93.6	93.8	94.0	94.2	94.4	94.5	94.7	94.9	95.1	95.3	95.5	95.7	96.0	96.2	96.4	96.6	96.9	97.2	97.5	97.8
-1.01	94.2	94.3	94.5	94.7	94.9	95.1	95.2	95.4	95.6	95.8	96.0	96.2	96.4	96.6	96.9	97.1	97.3	97.5	97.8	98.1	98.4	98.7
-1.02	95.1	95.2	95.4	95.6	95.8	96.0	96.1	96.3	96.5	96.7	96.9	97.1	97.3	97.5	97.8	98.0	98.2	98.4	98.7	99.0	99.3	99.6
-1.03	96.0	96.1	96.3	96.5	96.7	96.9	97.0	97.2	97.4	97.6	97.8	98.0	98.2	98.4	98.7	99.0	99.2	99.4	99.6	99.9		
-1.04	96.9	97.0	97.2	97.4	97.6	97.8	98.0	98.1	98.3	98.5	98.7	98.9	99.1	99.3	99.6	99.8						
-1.05	97.8	98.0	98.1	98.3	98.5	98.7	98.8	99.0	99.2	99.4	99.6											
-1.06	98.7	98.8	99.0	99.2	99.4	99.6	99.7	99.9														
-1.07	99.6	99.7	99.9																			

TABLE C.  
*Per cent. of Water—Specific Gravity.*

tempe- rature,	1.080	1.081	1.082	1.083	1.084	1.085	1.086	1.087	1.088	1.089	1.090	1.091	1.092	1.093	1.094	1.095	1.096	1.097	0.998	1.100	1.101
C.° F.°																					
2882.4	34.4	33.6	32.7	31.9	31.3	30.4	29.6	28.7	27.9	27.1	26.3	25.5	24.8	24.1	23.4	22.5	21.7	21.0	20.2	19.5	18.1
2780.6	34.7	33.9	33.0	32.2	31.5	30.7	29.9	29.0	28.2	27.4	26.6	25.8	25.1	24.4	23.6	22.8	22.0	21.2	20.5	19.8	18.4
2678.8	34.9	34.1	33.3	32.5	31.7	30.9	30.1	29.2	28.4	27.6	26.8	26.0	25.3	24.6	23.8	23.0	22.3	21.5	20.7	20.0	18.6
2577.0	35.2	34.3	33.5	32.7	31.9	31.1	30.3	29.5	28.6	27.8	27.0	26.2	25.5	24.8	24.0	23.2	22.4	21.7	20.9	20.1	18.7
2475.2	35.4	34.5	33.7	32.9	32.1	31.3	30.5	29.7	28.8	28.0	27.2	26.4	25.7	25.0	24.2	23.4	22.6	21.9	21.1	20.3	18.9
2373.4	35.6	34.7	33.9	33.1	32.3	31.5	30.7	29.9	29.0	28.2	27.4	26.6	25.9	25.2	24.4	23.6	22.8	22.1	21.3	20.5	19.1
2271.6	35.8	34.9	34.1	33.3	32.5	31.7	30.9	30.1	29.2	28.4	27.6	26.8	26.0	25.3	24.6	23.8	23.0	22.3	21.5	20.7	19.3
2169.8	36.1	35.2	34.3	33.5	32.7	31.9	31.1	30.3	29.5	28.6	27.8	27.0	26.2	25.4	24.7	24.0	23.2	22.4	21.7	20.9	19.4
2068.0	36.3	35.4	34.5	33.7	32.9	32.1	31.3	30.5	29.7	28.8	28.0	27.2	26.4	25.6	24.9	24.2	23.4	22.6	21.9	21.1	20.3
1966.2	36.5	35.6	34.7	33.9	33.1	32.3	31.5	30.7	29.9	29.0	28.2	27.4	26.6	25.8	25.1	24.4	23.6	22.8	22.1	21.3	20.5
1864.4	36.7	35.8	34.9	34.1	33.3	32.5	31.7	30.9	30.1	29.2	28.4	27.6	26.8	26.0	25.3	24.6	23.8	23.0	22.3	21.5	20.7
1762.6	36.9	36.0	35.1	34.3	33.5	32.7	31.9	31.0	30.2	29.4	28.6	27.8	27.0	26.2	25.5	24.8	24.0	23.2	22.5	21.7	20.9
1660.8	37.1	36.2	35.3	34.4	33.6	32.8	32.0	31.2	30.4	29.5	28.7	28.0	27.1	26.3	25.6	25.0	24.1	23.3	22.6	21.8	21.0
1559.0	37.3	36.4	35.5	34.6	33.8	33.0	32.2	31.4	30.5	29.7	28.9	28.1	27.2	26.5	25.8	25.1	24.3	23.5	22.8	22.0	21.2
1457.2	37.5	36.6	35.7	34.7	33.9	33.1	32.3	31.5	30.7	29.9	29.0	28.3	27.4	26.6	25.9	25.2	24.4	23.7	22.9	22.2	21.4
1355.4	37.6	36.7	35.8	34.9	34.1	33.3	32.5	31.7	30.9	30.1	29.2	28.4	27.6	26.8	26.0	25.3	24.6	23.8	23.0	22.3	21.5
1253.6	37.8	36.9	36.0	35.1	34.2	33.4	32.6	31.8	31.0	30.2	29.4	28.6	27.8	27.0	26.2	25.5	24.8	24.0	23.2	22.5	21.7
1151.8	38.0	37.1	36.2	35.3	34.4	33.6	32.8	32.0	31.2	30.4	29.6	28.8	28.0	27.2	26.4	25.7	25.0	24.2	23.4	22.7	21.9
1050.0	38.1	37.2	36.3	35.4	34.5	33.7	32.9	32.1	31.3	30.5	29.7	29.0	28.2	27.4	26.6	25.8	25.1	24.3	23.6	22.8	22.0
948.2	38.3	37.4	36.5	35.6	34.7	33.9	33.1	32.3	31.5	30.7	29.9	29.1	28.3	27.5	26.7	25.9	25.2	24.5	23.7	22.9	22.1
846.4	38.5	37.6	36.7	35.8	34.9	34.1	33.3	32.5	31.7	30.9	30.1	29.2	28.4	27.6	26.8	26.0	25.3	24.6	23.8	23.0	22.3

TABLE C.—CONTINUED.  
*Per cent. of Water—Specific Gravity.*

Tempe- rature.	1·102	·103	·104	·105	·106	·107	·108	·109	·110
C.° F.°									
28 82·4	17·3	16·6	15·8	15·1	14·4	13·7	13·0	12·3	11·6
27 80·6	17·6	16·9	16·1	15·4	14·7	14·0	13·3	12·6	11·9
26 78·8	17·8	17·1	16·3	15·6	14·9	14·2	13·5	12·8	12·1
25 77·0	18·0	17·2	16·5	15·7	15·0	14·3	13·6	12·9	12·2
24 75·2	18·2	17·4	16·7	15·9	15·2	14·5	13·8	13·1	12·4
23 73·4	18·4	17·6	16·9	16·1	15·4	14·7	14·0	13·3	12·6
22 71·6	18·6	17·8	17·1	16·3	15·6	14·9	14·2	13·5	12·8
21 69·8	18·7	18·0	17·2	16·5	15·7	15·0	14·3	13·6	12·9
20 68·0	18·9	18·2	17·4	16·7	15·9	15·2	14·5	13·8	13·1
19 66·2	19·1	18·4	17·6	16·9	16·1	15·4	14·7	14·0	13·3
18 64·4	19·3	18·6	17·8	17·1	16·3	15·6	14·9	14·2	13·5
17 62·6	19·5	18·8	18·0	17·3	16·5	15·8	15·0	14·3	13·6
16 60·8	19·7	19·0	18·2	17·4	16·7	16·0	15·2	14·4	13·7
15 59·0	19·8	19·1	18·4	17·6	16·9	16·1	15·4	14·6	13·9
14 57·2	19·9	19·2	18·5	17·7	17·0	16·2	15·5	14·8	14·1
13 55·4	20·0	19·3	18·6	17·8	17·1	16·3	15·6	14·9	14·2
12 53·6	20·2	19·5	18·8	18·0	17·3	16·5	15·8	15·0	14·3
11 51·8	20·3	19·6	18·9	18·2	17·5	16·7	16·0	15·2	14·5
10 50·0	20·5	19·8	19·0	18·3	17·6	16·9	16·2	15·4	14·7
9 48·2	20·6	19·9	19·2	18·5	17·7	17·0	16·4	15·6	14·8
8 46·4	20·7	20·0	19·3	18·6	17·8	17·1	16·5	15·8	15·0

*Mineral Produce of South Wales.*

On his examination before the committee of the South Wales Railway, Mr. Buckland stated that during last year, 220,000 tons of iron, and 600,000 tons of coal were exported from Newport, and from Merthyr to Cardiff no less than 180,000 tons of iron annually, and that this trade was increasing daily. From Newport and Cardiff, iron ores were exported in considerable quantities, and from the latter place there was a large export trade to Ireland. From Bristol and Gloucester there were exported to Cardiff, in the year ending June, 1844, 80,000 tons, and from Cardiff to the other ports, 10,000 tons, which did not include coals. The total quantity of iron produced during the year in the district was from 450,000 to 500,000 tons, which, at the low average of 1844, was, 4,500,000*l.* in value. The tin plates produced in that part only of the district through which the proposed railway would pass, was between 27,000 and 28,000 tons, over 800,000*l.* in value. There were 55,720 tons of copper ore imported into the country last year, of which 43,734 tons were smelted at Swansea, the total value of which was about 2,000,000*l.* The whole metallic manufacture of the district amounted in value in one year to between 9,000,000*l.* and 10,000,000*l.*, while there were large quantities of timber and charcoal produced in Herefordshire.

*Notice of the method of Puddling Cast-Iron at Montblainville, (Meuse,) by means of the combustible gases from a refinery fire.*  
By M. SAUVAGE, Engineer of Mines.

Translated for the Journal of the Franklin Institute, from the *Annales des Mines*.

The waste heat from refinery fires is successfully applied, in a great number of establishments, to various metalurgic operations, which do not require a very high degree of heat.

At the time when M. Ebelman devoted himself to the important researches, which he has published, upon the composition of the gases which are disengaged from these furnaces, some unsuccessful attempts had already been made to carry on the operation of puddling by their aid. But it attracted the attention of M. Ebelman that a current of hot air, projected at the same time, through several orifices, (such as is now used for the combustion of the gases of a smelting furnace,) had not yet been used to burn the gases from a forge fire.

This new application of waste heat has recently been the subject of numerous experiments at the works at Montblainville, and the operation of puddling is there practised in a manner sufficiently regular and advantageous to justify the belief, that it will be useful to publish the results. The refining fire, it is true, is not sustained by pure charcoal, but by a mixture of charcoal and a large proportion of baked or dried wood. The conditions, therefore, are not the same as in common refineries.

*General arrangement of the Apparatus.*

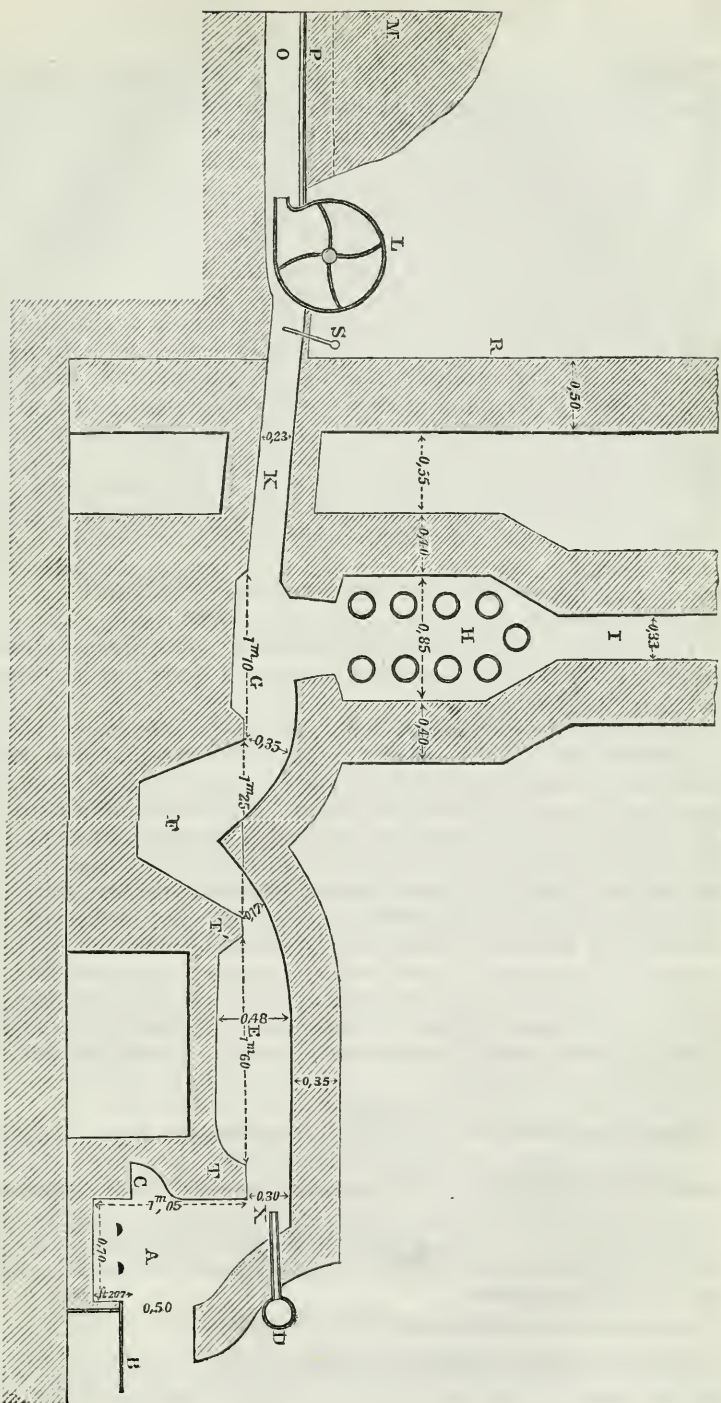
A, Is the refinery fire with two tuyers connected with one another.  
B, Working opening.

C, Small furnace for heating the cast iron to be converted into loupes in the refinery fire.

E, Puddling furnace into which the flame from the refinery fire passes, after going over the main bridge wall T.

D, Horizontal pipes which project air, previously heated to 300° C. (572° F.) into this flame, through 7 tubes or small tuyers, each 0.02 m. (0.79 ins.) diameter, arranged parallel to each other in the width of the furnace. This current of compressed hot air, burns the gases almost entirely in the space E, where the highest temperature is required. What escapes combustion passes with the other products of combustion, over the small bridge wall T, afterwards into the flue F, then serves to heat the cast iron for the next charge, and finally escapes through a low chimney (only a few feet higher than the roof of the works,) after having heated the blast in the apparatus H. This apparatus is arranged like that at Wasserhalffingen; it consists of nine straight pipes joined by elbows or bends; each pipe exposes 9.67 square feet of surface to the flame; seven of these pipes heat the blast for the puddling furnace, and the other two for the refinery fire.

A small part of the waste heat is drawn off through a brick flue K, by a fan made of cast and sheet iron, and is driven into a pile or heap of wood to dry or bake it, for the use of the refinery fire.



*Method of Working.*

*Refining.*—The cast iron used comes from a smelting furnace supplied with dried wood and hot blast. The fuel is a mixture of nine parts by bulk of dried wood to one of charcoal. The wood is of various kinds, weighing in the forest, after being cut six months, from 2800 to 3000 lbs. per cord of 128 cubic ft. (350 to 375 Kil. la stere.) The product of the refinery consists exclusively of plough shares.

The refinery fire has two tuyeres of 0.985 ins. diameter. The mean pressure of the blast is 1.57 ins. mercury = 0.77 lbs. per square inch, and its temperature from 176° to 212° F.\*

The manner of working is the same as usual; the workman charges with about 132 lbs. of cast iron previously heated in the furnace C; during the refining, properly speaking, he employs only dried wood, which gives to the refinery fire, a sufficiently high temperature for this phase of the operation, and to the puddling furnace a more abundant and longer flame than the charcoal will make. As soon as the loupe is taken out of the refinery fire to be shingled, the workman fills up the furnace with about (2.47 cub. ft.) 1½ heaped bushels † of charcoal, covers this over with a little dried wood, and then puts in a new charge of cast iron. The use of charcoal at this period of the operation, is indispensable, in order to be able to heat the loupe, which will be brought back after shingling, to a white welding heat.

The loupe is heated and drawn out under the hammer in the usual manner. The refining and drawing out of a loupe requires from one and a half to two hours.

*Puddling.*—The same cast iron is used in the puddling furnace as in the refinery fire. In commencing to work with the latter, the puddling furnace is gradually heated; the puddler prepares the hearth, and heats to redness a charge of from 374 to 440 lbs. of cast iron, in the furnace G. As soon as he judges that the furnace is sufficiently hot and that the hearth is ready, which is generally in about 4 or 5 hours, he places the cast iron which has been already heated to redness, in the puddling furnace, and puts another charge into the furnace G. The operation is afterwards conducted in the usual manner. The time required for one heat is about the same as for the refinery fire. The furnace works for 15 days without repair. The quality of the iron appears to be much superior to that made in the coal furnaces, under the same circumstances, and is more similar in this respect, to the iron made with wood.

\* The formula  $Q = 289 d^2 \sqrt{\frac{h(1+0.0037 t)}{b+h}}$ , or converted into English measures,  $Q = 948 d^2 \sqrt{\frac{h(1+0.00206(t-32))}{b+h}}$ , gives when  $d = 0.082$  feet,  $h = 0.1312$  feet.  $b = 2.46$  feet,  $t = 194^\circ$  F.  $Q = 1.66$  cub. ft. per second, and for two tuyeres 3.32 cub. feet, at temperature of  $194^\circ$  F., and under a pressure of  $b+h = 2.59$  feet or 31.2 ins. mercury. The volume of air reduced to  $32^\circ$  F., add with the barometer at 29.85 ins. is 2.58 cubic feet, and per minute 155 cubic feet.

The velocity of the air per second is  $\frac{1.66 \times 4}{\pi d^2} = 312$  feet.

† Heaped bushel contains 2815.48 cubic inches.

*Drying of the Wood.*—The fan, I, receives its motion from the wheel of the blowing machine, by means of a cord and pulleys. It draws part of the gases from the furnace, through the flue K, and forces them into a channel built of stone, from 20 to 23 feet long, one foot square in section, and built under the surface of the ground. This channel is covered with cast iron plates, 16 inches wide, raised about four-tenths of an inch above the vertical walls, in such manner as to cause the gases to escape at the sides horizontally.

The pile of wood to be dried, containing about 1400 cub. feet, or 11 cords, is arranged upon an elliptical base, of which the channel O, is the longer axis, and it is covered over with earth and cinders. The wood is placed so as not to touch the cast iron plates.

The speed of the fan, and the position of the small damper S, are so adjusted as to maintain the pile at a temperature of about 392° F. After three or four days the wood is dried; it loses about 25 per cent. of its weight, and 10 per cent. of its bulk, and the color becomes slightly brown. It is in every respect similar to that obtained by the Echrement process, which we have before described.—(*Annales*, t. xviii, p. 677.)

#### *Consumption and Products—Comparisons.*

From the 1st of September, 1843, to the 31st March, 1844, the refinery fire working in the old manner, consumed 167·810 Kil. = 165 tons of cast iron, and 1060 met. cub. = 23·002 heaped bushels of charcoal, of which one-seventh part is for loss in the store sheds (this loss is real, and is verified by the experience of several years.) It has produced 117½ tons of plough shares, being 14·72 tons per month.\*

The consumption for each ton of plough shares has been 1·4 tons of cast iron, and 195 heaped bushels of charcoal.

This consumption is great, but it should be observed that the plough shares when taken from the refinery fire are only “roughed out,” and it is necessary to heat them again, in a heating furnace, before being plated out, from which another loss is sustained; but the calculation of the consumption, the refinery fire is based upon the weight after being plated out.

In April, this year, 1844, the apparatus was arranged as it is now: in May, June and July several changes have taken place in the work of the refinery fire, which has sometimes produced blooms (pieces cinglies) sometimes iron bars, sometimes plough shares; on the other hand the workmen have had to acquire experience in the new method; it is therefore impossible to have precise data for comparing the working of these four months with the preceding period.

In August, 1844, the working was altogether regular, and the operation quite complete; the refinery fire consumed:

21·017 Kil. = 20½ tons of cast iron,

29·03 mc. = 630 heaped bushels charcoal,

201·54 “ = 4373 “ “ of dried wood.†

And produced 14½ tons of plough shares.

\* This is an error, from 1st September, 1843, to 31st March, 1844, is but 7 months—the production was therefore 16·82 tons per month, instead of 14·72.—*Trans.*

† We use this unusual measure for wood in order that the relative quantity of wood and charcoal may be seen at a glance.—*Trans.*

The consumption per ton of plough shares (with the same workmen and same products as in the period from September, 1843, to March, 1844,) has therefore been:

14.25 Kil.	=	1.42 tons cast iron,
1.97 mc.	=	42.75 heaped bushels of charcoal,
13.67 mc.	=	296 heaped bushels of dried wood.

During the same month (August, 1844,) the puddling furnace consumed 58 tons of cast iron and produced 51.9 tons of blooms. That is for each ton of blooms, 1.118 tons of cast iron, a great consumption occasioned by the use of a considerable proportion of burnt and oxidized cast iron scrap. The usual rate of working (in July, 1844, for example,) does not exceed 1.09 tons of cast iron, which is the same proportion as in puddling furnaces with coal.

From a comparison of the work during these two periods, the following conclusions are drawn:

1st. The monthly production of the refinery fire was	14.72 tons.
It is now only	14.50 "

Difference,	0.22 "
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which is insignificant, and will disappear when the workmen have more experience.

2nd. The consumption of cast iron is increased 63 lbs. which may be represented in money, by \$0.68.

It may happen that this increased consumption is due to causes foreign to the introduction of the new process. Thus the refinery fire is now at a distance from the hammer, and therefore disadvantageous for working.

3rd. The consumption of charcoal was 192 heaped bushels, weighing 20.27 lbs. per bushel, or 3894 lbs.; and as the wood of this neighborhood yields about 7.6 lbs. of charcoal per bushel, this consumption corresponds with that of 512 bushels of wood. It includes, as we have already said, a loss of one-seventh, so that the effective consumption of the refinery fire is,

	3894 lbs.
Less---one-seventh	556 "
Or	3338 "
and of wood $\frac{3338}{7.6}$	or 439 bushels.

From the actual working the consumption is—

1st. 1.90 mc. or 41.23 heaped bushels of charcoal weighing 836 lbs. and corresponding to	-	110 bushels of wood.
and 2nd. 13.67 mc. or 306 $\frac{2}{3}$ heaped bushels of dried wood, produced by	329.8	" "
	<hr/>	
Total,	439.8	

To obtain the effective expenditure of the refinery fire, one-seventh of the whole weight of charcoal used must be deducted, that is,  $\frac{836}{7}$

or = 119.4 lbs., corresponding to 15.6 bushels. The total consumption is therefore 424 $\frac{1}{4}$  instead of 439 bushels.

The substitution of dried wood for charcoal seems to give a trifling economy of fuel, (14 $\frac{3}{4}$  bushels.) Nevertheless, this economy is really greater than the results of the preceding calculations seem to indicate. In effect, although the flame of the refinery fire is sufficient to maintain, almost constantly, a suitable temperature in the puddling furnace, it is certain that during the period of "letting or cooling down," which precedes the withdrawal of the loop, the refinery fire might become very low if it were used for no other purpose; therefore, the fuel that is added at this time to prevent the cooling of the puddling furnace, should be charged to the latter. It is an extremely difficult matter to determine, exactly, the relative quantity. Messrs. Bellevue and Lovat, who have placed me under the greatest obligations by furnishing this information, and whose accuracy may be relied upon, estimate it at  $\frac{1}{4}$ th of the whole consumption, or 60.68 bushels. This quantity, added to 14 $\frac{3}{4}$  bushels, represents the total economy of fuel.

In order to appreciate the proportion of heat lost to that which is used in the refinery fire, it should be considered that the latter produces generally 94.6 lbs. iron in 1.75 hours, consuming during this time 18.22 bushels of wood, or 10.4 bushels per hour, capable of developing about 3600 "calories"\* or units of heat per kilogramme; or in English terms, each pound of wood is capable of heating 6480 lbs. of water one degree Fahrenheit. The total number of English units is, therefore,  $6480 \times 10.4$  multiplied by the weight of a bushel of dried wood,  $28.4 = 1893932$ . During the same time, (one hour and three-quarters) the puddling furnace has produced about 330 lbs. of iron, which, by the ordinary treatment, would require the use of 214 $\frac{1}{2}$  lbs. of coal, that is, per hour, 122 $\frac{1}{2}$  lbs. But a kil. of coal can develop 7.500 French calories, (units of heat,) or in English terms, 1 avoird. develops 13.500 English units; these 122 $\frac{1}{2}$  lbs. will give 1653750 units of heat, or 85 per cent. of the value of the combustible used. This comparison, moreover, is not strictly correct, because the waste heat which escapes from a furnace burning 121 lbs. coal per hour, is incomparably greater than that which the combustible gases of Montblainville possess when they come out of the apparatus, although the latter is still sufficient to heat the air and char the wood necessary for the working of the refinery fire.

If the question be now considered financially, which, after all, is the most important, we see that formerly the consumption was 192 heaped bushels of charcoal, at 11 $\frac{1}{3}$  cents, \$21.75

It is now 42.75 bushels of charcoal, at 11 $\frac{1}{3}$  cts.

per bushel,

\$4.84

And 296 heaped bushels of dried wood, at

5.53 cts. per bushel,

16.36 = \$21.20†

Apparent economy,

0.55

\* The French unit of heat is one kil. of water heated 1° Centigrade; this corresponds with 3.968 avoird. lbs., heated 1° Fah.

† Price of Charcoal.—3.575 cords, or 282 heaped bushels of wood at \$2.38 per cord, were

From the supposition that  $\frac{1}{7}$ th of the expense,  $\frac{\$21.20}{7} = \$3.03$ , should be charged to the puddling furnace, we should only reckon \$18.17 to the refinery fire, and a saving of \$3.58 per 1000 kil., or 3.64 per ton should be attributed to the substitution of dried wood for charcoal.

As the puddling produces about  $3\frac{1}{2}$  times as much iron as the refinery fire, in the same time, the expense of \$3.03 only adds 0.86 $\frac{1}{2}$  cents per ton of puddled iron.

The puddling furnaces of Montblainville, which have been idle for some time in consequence of the high price of fuel, do not use less than 1430 lbs. of Liege coal of good quality for each 1000 kil. of blooms, or 1453 lbs. of Liege coal per ton. The Belgian coal costs now 7.62 per ton, delivered at Montblainville; the 1453 lbs. will come to \$4.96. The nett saving is, therefore, \$4.96 less 86 $\frac{1}{2}$ , or \$4.10 per ton.

To recapitulate, the economical results are,—

1st. For the refinery fire, \$3.64 per ton, and per month on 14 $\frac{1}{2}$ tons,	\$52.78
2nd. For the puddling furnace, \$4.10 per ton, and per month on 51 tons,	209.10

Monthly economy,	\$261.88
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*Expenses of the Construction and Establishment of the Apparatus.*

The puddling furnace of Montblainville differs from an ordinary furnace only in the substitution of the refinery fire for the grate, the suppression of the large chimney, and the addition of a hot air apparatus.

The construction of this apparatus may be valued at from 75 to 100 dollars. The two fans, and the plates over the flue walls, might cost about as much more, making the total expense in ordinary cases from 150 to 200 dollars; which expense is in part balanced by the saving from the suppression of the high chimney for draft.

An establishment which would use three refinery fires and a pair of rolls, could have a complete system of puddling and rolling, or drawing out. One of the fires would serve to heat a furnace for re-heating the iron, which would come from the other two. The experiment of re-heating has been successfully made at Montblainville, by the temporary conversion of a puddling into a welding furnace.

charred in the forest,	\$8.53
The cost of charring amounted to	.56
Transportation,	.75
Total,	\$9.84
The product obtained was 87.0 bushels of charcoal, costing, therefore, 11 $\frac{1}{2}$ cents per bushel.	
<i>Price of Dried Wood.</i> —There was dried 0.55 cords, or 43.4 bushels of wood, at \$2.38	
per cord,	\$1.31
Drying at the works, at 9 cents,	.18 $\frac{3}{4}$
Transportation,	.23 $\frac{1}{4}$
Sawing,	.18 $\frac{3}{4}$
	\$1.92

And 39 bushels or 0.49 of a cord of dried wood was obtained, the cost was, therefore, \$3.92 per cord, or 49 $\frac{1}{4}$  cents per bushel.

*Account of the various Improvements made in the Stocking Frame from its invention to the present day, and its connexion with the Lace Manufacture.*

[From the Report of the Commissioners appointed to inquire into the condition of the Framework Knitters, 1845.]

In a memorial addressed to the Lords of the Treasury in 1834, against the exportation of machinery, from the merchants, manufacturers, and others at Nottingham, engaged in the manufacture of silk and cotton bobbin-net lace, the introduction and importance of this manufacture is thus spoken of:—

“The fabrication of thread and silk lace is a very ancient and extensive manufacture, the manner of making which, by the hand, is a very complicated, tedious, and slow process, and, of consequence, such lace is very expensive and costly.

“That the manufacturers of such lace, particularly of the most costly fabrics, principally resided in the northern provinces of France, in Brabant, Flanders, and the Low Countries, where the female population were to a great extent employed in making lace.

“That although the making of the inferior kinds of lace was extensively carried on in the counties of Buckingham, Bedford, and Northampton, and the superior fabrics to a small extent in Devonshire, yet such was the demand for foreign laces in these dominions, that Parliament was induced to prohibit the importation of such laces, as it caused a visible diminution in the amount of British specie, and weakened the resources of Britain, whilst it added to the power, wealth, and aggrandizement of France, and the possessors of the Low Countries.

“That the superseding of hand labor by machinery, in the carding and shearing of cotton and other cloths, had been early invented in England, and the use of such carding machinery was prohibited (by the 5th and 6th of Edward VI., cap. 22,) on account of its damaging the cloth in the process, from the imperfection of its construction; so that the knitting or stocking frame was the first invention successfully used for superseding hand labor by the use of a machine, in making clothing.

“That in the latter end of the reign of His Majesty George II., or about 150 years after the invention of the said knitting machine, a number of appendages were applied to the said stocking frame, one of which, termed the tickler machine, by mere accident, was applied to the making fabrics in imitation of lace, by removing the stocking loops in various directions. This attempt was succeeded by another invention, termed a point-net machine, consisting of a machine appended to the frame, which made the net without removing the stitches; and this invention, after numerous attempts to make it sound, nearly superseded the making of silk lace by the hand.

“Your memorialists further show that this net, though an imitation of bobbin-lace, was yet inferior in many essential points to those fabrics, particularly in retaining its appearance of lace, when unstiffened;

notwithstanding which defect, no less than 1200 workmen were employed at one period in making it, and more than 20,000 persons in ornamenting the net, and preparing it for sale.

"That so early as the year 1770, attempts were made to produce bobbin-nets by machinery, in exact imitation of those made by the hand, having the threads traversed and twisted round each other. To accomplish this object a machine was invented to plat a warp at both ends, in imitation of a machine brought from Switzerland, but this was found too slow a process; small brass winding bobbins, having teeth, and rolling in other rack teeth were essayed; threads wound upon wire, tier upon tier of hooks, revolving wheels on slides, and hundred of other experiments were tried, and though the bobbin mesh was by these means effected, yet the want of speed and accuracy of working rendered all the plans abortive. Numerous attempts were made during this period in Scotland, London, and many parts of the kingdom, to make fishing-nets by machinery, which was for several years also essayed at Nottingham. A workman employed in making and inventing such machinery, at length discovered, through accidentally seeing a child at play, the formation of the bobbin and carriage now used in the bobbin-net machine, which was first applied to the making of fishing-nets. Notwithstanding this discovery, none of the inventors could apply it to a machine to make bobbin-net. So great was the difficulty, and such the number of abortive attempts, that the projectors were ranked amongst the enthusiasts who were seeking to obtain the perpetual motion. Two men, named Simpson and Green, actually died from a disease of the brain, brought on by unremitting and unrequited study.

"At length, in 1809, a machine to make bobbin-net was completed, which had passed through the hands of no less than six of the most ingenious and indefatigable mechanics then known, whose labors had been abortive, though they had passed their lives in similar attempts.

"The machine thus accomplished, after 40 years' experiments in different parts of the kingdom, was yet surprisingly complex and slow in its movements, having 24 motions to the series for twisting the mesh, and four motions for the pins to secure the twist from unraveling.

"This complex machine, before the expiration of the patent, was simplified so as to require only 13 motions to complete the same mesh, and two to prevent the unravelment; two other improvements reduced the motions to 11, and two motions for preventing the unravelment; and at length the utmost acme of speed was accomplished, by reducing the motions to six, and performing the two motions to prevent unravelment at the same time that the other motions were made; whilst a number of machines to any extent were constructed, so as to be propelled by steam and water power. The original machine only possessed speed sufficient to make one rack, of 240 holes in length, in an hour, while the power-impelled machines can make six such racks in an hour; in addition to which, the original machines made nets from one yard to one yard and a half in width, whereas machines are

now made to fabricate net, three, and even four yards in width, thus increasing the speed of the machinery twelvefold.

"To accomplish these surprising improvements, one gentleman has expended the whole of his property, amounting to from 50,000*l.* to 70,000*l.*, whilst others have made similar sacrifices, in proportion to their means.

"That in addition to the improvement upon the principle of the original machine, other modifications of the principle of making bobbin-nets, by the bobbin and carriage, have been accomplished:—by traversing the warp instead of the bobbin-thread; by placing the carriages in a single line, instead of a double line, as in the original invention; all of which improvements or modifications have been made with an immense outlay of capital, and by intense study, care, ingenuity, and perseverance. That in addition to which, though the original machine was only calculated to make plain net in a broad piece, unornamented, yet, by the application of unceasing ingenuity, regardless of expense, various ornaments have been worked into the net by machinery, whilst the net, instead of being made in broad pieces, is worked into slips, exactly imitating the cushion net. The result of making such lace by machinery has been to reduce the foreign cushion lace workers to less than a tenth in number, and England has become a great exporting nation for lace, to the amount of two millions annually, instead of being an importing nation to nearly that amount. Permit your memorialists here to draw your Lordships' particular attention to a recapitulation of the exact position of their trade. Extraordinary study, skill, and invention were applied for 40 years to make the first bobbin-net machine; then continued application for 20 years more has been necessary to bring it to its present degree of perfection. The vast amount of capital sunk during the last 20 years in the machinery now employed, is seen in the incontrovertible fact that, out of the 5000 bobbin-net machines now employed in the English trade, the 3500 machines first constructed, at a cost of two millions sterling, have, by improvements alone, been reduced to the value of 200,000*l.*, leaving the English trade minus 1,800,000*l.* If continental nations succeeded in obtaining a sufficient number of our improved machines to supply themselves, which is their present effort and design, no part of the outlay in invention and improvement can ever be regained; and your Lordships will perceive the jeopardy in which these continental rival manufactories will place our trade, in which 2,000,000*l.* is still invested in capital, and 2,500,000*l.* is paid yearly in wages to between 150,000 and 200,000 persons."

\*                      \*                      \*                      \*

Until the discovery of the bobbin-net machine, all lace was made by an appended machinery to the stocking frame. Sixteen descriptions of bobbin-net machines were attempted (and some of them brought to work) previous to Mr. Heathcote's patent in 1839.

An analysis of the whole of the inventions in lace machinery gives the following results:—

Inventions, previous to Heathcote's patent, for making bobbin-net,	16
Inventions on the double-tier principle,	57
Inventions on the traverse-warp principle,	11
Inventions on the pusher principle,	16
Inventions on Levers's principle,	28
Inventions to make fender-net, called loop-net,	3
Inventions to make foreign cushion-net by machinery,	6
Inventions on the double set of carriage principle,	4

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The number of inventions in warp lace is not quite so numerous, but they are equally important.

The invention of the thread-carrier, in 1789, more than doubled the speed of the loom and the stocking frame, and is regarded as the foundation of the fly-shuttle and other momentous improvements in manufacturing skill.

The following are modes of work of fabricating lace and framework knitted manufactures, introduced from foreign states:—

1. Round-fingered gloves from Madrid in Spain.
2. Tuck-ribs from Lyons in France.
3. Plated plain work from Nismes in France.
4. Figured warp shawls, the colors worked in on the frame, as practised by Messrs. Hames, at Melbourn. From Lyons.
5. Figured-warp handkerchiefs in various devices, by open works, &c. Lyons.
6. Porcupine point-net scarfs. Troyes and Lyons.
7. Sandal open work plain silk shammies. Paris and Troyes.
8. Knotted hose without seam. Lyons and Barcelona.
9. Round feet in hose. France and Spain.
10. Figured-tied silk stockings. Now obsolete. France.
11. Chevening by hand. France.
12. Chevening in gold and silver, as well as silk, on the frame. Lost. From Cordova and Seville in Spain. The trade has now nearly left those places, and has removed to Barcelona, Valencia, Madrid, and Talavera de la Reyna.

The following are inventions used by foreign states, unknown, or at least not practised in these kingdoms:—

1. Pin machine for making point-net. Lost to the English. France.
2. Trico Berlin machine for making lace in stripes, and to represent feathered work. France, Prussia, Saxony.
3. Cylinder-warp machine to flower the net on the frame. France.
4. Cylinder-tickler machine for making fancy net-hose. France.
5. Machine for working plain stocking-work in colored figures, the same as knit, by using a number of colored bobbins, so as to make a representation of flowers, &c. Barcelona and Turin.
6. Machine for making a sort of Brussels lace in the plain silk stocking. Valencia in Spain.
7. *Metier au Griffre*, or frame on two trucks, having no half-jack, and only a top cramp on jack-springs. France.
8. Revolving slur-wheel stocking frame, which forces down the

jacks without a slur-cock, for cold countries where jacks would not fall. Denmark, Russia, United States of America.

In the preceding enumeration of the various inventions that have been made from time to time, it has been shown that the lace trade has emanated from the stocking-frame, as well as the hosiery trade; I have not therefore attempted to dis sever the connexion existing between them (which locality seems also to aid in perpetuating) by separate descriptions of the improved machinery which now relates exclusively to the one or to the other. Those familiar with either trade will at once discover, and be enabled to make the distinction. It is, however, I think manifest that the popular opinion that the stocking frame has received no improvement since its first formation is erroneous, and that time has introduced into this machine many important and salutary amendments. Its peculiar characteristic of having escaped the propelling and invincible power of steam, to which even the winds and the waves may be said to have been constrained to submit, has been ascribed to the fact that the varied movements of the body, hands, and legs, which are each called into action in the working of a stocking frame, are all necessarily mainly regulated and guided by the eye. In the finer work especially, the tax upon this organ is often of great severity, which is shown by the number of middle-aged men who are found using spectacles when at work; and confirmed still further by the fact that, as age advances on the operative, he is invariably found receding from the work of the finer to the coarser gauged frames, long before bodily decrepitude would necessitate the change.

Other and totally different causes may have contributed to discourage any attempt to apply mechanical power to the stocking frame. If all obstacles to a correct and properly made article of hosiery by such means could be overcome, it is doubtful whether, in a pecuniary point of view, it would be a measure of economy in the employers to adopt it. While wages remain, as they have done for years past, almost at the minimum of existence to the workman; while custom sanctions, and his defenceless poverty forces him to submit to pay an exorbitant and disproportionate weekly rent for the machine in which he works; while the mode of constructing the business remains in force, which actually prescribes the very limits of the labor he shall perform, as subsequently shown in the practice of stinting; and while at any time the employer can at little sacrifice to himself lay down his one, his ten, or his hundred frames,—even the rental of the places in which they stand, when at work, being paid by the workmen, there must be great advantages clearly manifested, as derivable from any new system of production, which shall preponderate over those yielded by the present one.

Lond. Mech. Mag.

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*Application of Electricity in the Extraction of Metals.*

At a recent meeting of the Society of Arts, Mr. Whishaw (secretary) read a paper, by Mr. Napier, "On Separating Metals from their Ores

by means of Electricity." The author's mode of operation is as follows:—He uses a blacklead crucible, lined inside, within an inch or two of the bottom, with a coating of fire-clay, which is allowed to dry, and a second and third coat superadded; the ore to be operated on (which, if a sulphate, should be previously roasted) is put into the crucible, together with a little lime or other flux for the purpose of giving it fluidity. The crucible, with its contents, is then placed in a common crucible furnace; a battery of zinc and copper is prepared with five pair of plates, excited by very dilute sulphuric acid; to the zinc of this battery is attached an iron rod, the end of which is inserted in the furnace, and caused to touch the outside of the crucible; another rod, either of iron or copper, is used, having at one extremity a disk of iron or coke, which is made to rest on the surface of the fused mass in the crucible. The electricity is thus passed down through the whole fluid mass in the crucible, and in the course of an hour the metal is separated from the ore and deposited at the bottom. *Ibid.*

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#### *Submarine Currents.*

M. Arago presented to the Academy of Sciences, Paris, in the name of M. Aimé, two instruments, one to ascertain the direction of submarine currents, the other to measure their speed. These instruments were accompanied by an account of several experiments which had been made with them: it states, amongst other things, that the greatest speed of the currents on the coasts is on the coast of Africa, between Algiers and Bona, and not, as is generally supposed, between Gibraltar and Algiers, and that in the Straits of Gibraltar there are three parallel currents. Near the coasts the direction is from east to west, whereas the central current proceeds constantly from the west to the east; the latter is seven miles wide between Trafalgar and Cape Spartel. The width of the strait, at its narrowest part, is twelve miles; between Trafalgar and Cape Spartel it is twenty-seven miles; and fifteen miles between the Point of Europe and Centa.

*Lond. Mining Jour.*

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#### *Quantity of Coals, Cinders, and Culm, shipped at the several Ports of Great Britain, during the years 1843 and 1844.*

A return, moved for by Mr. Vivian, M. P., shows that the total quantities of coals, cinders, and culm, shipped at the several ports of the United Kingdom coastways to other ports of the United Kingdom, amounted altogether in 1843 to 7,447,084 tons, of which 7,138,107 were coals; and in 1844, to 7,377,862 tons, of which 7,017,113 were coals. The quantities exported to foreign countries amounted in 1843 to 1,866,211 tons of which 1,367,925 tons were large, and 452,356 small coals. The declared value of the whole amounted to 690,424*l.* The large coals were chiefly exported to Russia, Denmark, Prussia, Germany, Holland, and France, the United States of America, the British West Indies, and Brazil. France alone took 358,874 tons of large coal, and 99,720 of small coal. The quantities exported in 1844

amounted to 1,289,957 tons of large, and 408,424 tons of small coal, the declared value of all the coals, cinders, and culm being, 672,056*l*. The total amount of duties received on the coals exported in 1844 appears to have been 118,493*l*.—viz., 76,095*l*. on those exported in British, and 40,708*l*. on those exported in foreign ships entitled to the privileges conferred by treaties of reciprocity. The rates of duty were, on coals exported in British ships to foreign countries, 2*s*. per ton, and in foreign ships 4*s*. per ton. Ibid.

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*On the Connexion between the Winds of the St. Lawrence and the Movements of the Barometer.* By W. KELLY, M. D., Surgeon R. N., attached to the Naval Surveying Party on the River St. Lawrence.

The author adduces a great number of observations, which are in opposition to the generally received opinion, that the mercury in the barometer has always a tendency to fall when the wind is strong, During a period of fifteen years passed in the Gulf and River St. Lawrence, he found that the barometer as frequently rises as falls under the prevalence of a strong wind; and that the winds often blew with a greater force with a rising than with a falling barometer. He gives a circumstantial account of the progress and course of various gales which came under his observation during that period, and from which he infers the existence of a steady connexion between the prevailing winds of this region and the movements of the barometer, and enters into an inquiry into the mode in which that instrument is affected by them. The extensive valley of the St. Lawrence is bounded at its lower part, for a distance of nearly 500 miles, by ranges of hills, rising on each side to a considerable elevation. Within this space the ordinary winds follow the course of the river: and in almost every instance where they approach from windward, the barometer rises with them; and when, on the other hand, the wind approaches from leeward, the barometer not only falls before the arrival of the wind, but continues to fall until it has subsided. An appendix is subjoined, containing extracts from the tabular register of the barometer and winds at various points in the valley of the St. Lawrence, during the years 1834 and 1835, accompanied by remarks on different points deserving notice in particular cases.—*Proceed. Royal Soc.* London Athenæum.

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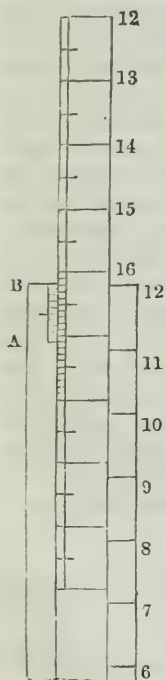
*On the Elliptic Polarization of Light by Reflexion from Metallic Surfaces.* By the REV. BADEN POWELL.

In a former paper, published in the Philosophical Transactions for 1843, the author gave an account of the observations he had made on the phenomena of elliptic polarization by reflexion from certain metallic surfaces, but with reference only to one class of comparative results. He has since pursued the inquiry into other relations besides those at first contemplated; and the present paper is devoted to the

details of these new observations, obtained by varying the inclination of the incident rays and the position of the plane of analyzation, and by employing different metals as the reflecting surfaces. By the application of the undulatory theory of light to the circumstances of the experiments and the resulting phenomena, the law of metallic retardation is made the subject of analytic investigation. A polariscope of peculiar construction, of which a description is given at the conclusion of the paper, was employed in the experiments; and tables are subjoined of the numerical results of the observations. Ibid.

*Vernier Slide-Rule for taking Exact Measurements.*

SIR.—Having had occasion to make some measurements with minute accuracy in circumstances where a common rule could not be conveniently applied, and not finding in the tool-shops any modification of it that suited my purpose, I contrived one for myself; and as it appears to me to be a great improvement on those in common use, I subjoin a sketch, not doubting that it will be received with pleasure by many of your readers.



The annexed figure represents a 12 inch rule with a slide—the numbering of the inches on the rule itself running upwards, and those on the slide returning in the opposite direction, so that the extent of interval between the extreme ends when the slide is drawn out, is shown at the intersection of the rule and slide. At the top of the rule, a space, A, B, equal to nine-tenths of an inch is divided into ten equal parts, and thus forms a vernier, enabling us to read off the length to the hundredth of an inch. In the diagram the distance between the ends is above 16·1 inches, and under 16·5 inches, the coincidence of 9 on the vernier with a graduation on the rule, shows it to be 16·19 inches. The degree of minuteness in subdivision can easily be increased at pleasure to any extent that the accuracy of the workmanship and the nicety of the observations may render desirable.

The principle can be readily applied to any form of rule and seems particularly well suited for measuring the internal diameter of a tube or cylinder. The length of a line is thus determined not by the application of the thumb-nail or the scratch of a piece of iron or other such rude method, but by the coincidence of the divisions of the scale itself, and is thus evidently susceptible of much greater precision.

This kind of rule is so simple and so much superior to those in common use; its principle is, moreover, so obvious, that I was very much surprised to find none such already constructed. A vernier usually slides upon a scale, and here the scale slides upon the vernier; this inversion of their relative positions is the only novelty in the present arrangement.

A rod with a slide in it and graduated like this rule, would, I think, be an improvement in the poles used for leveling; the sights might then be directed, not to a graduation on the pole, but to a fixed object on the slide, specially designed for that purpose, and which might be elevated or depressed at pleasure, by a racked wheel, and its height seen by the intersection of the rod and its slide.

Glasgow Prac. Mec. & Eng. Mag.

*On the Advantages of working Engines with High-pressure Steam expansively, and at great Velocities.* By J. G. BODMER.

The author based his observations upon the principle of a considerable area of piston being essential for taking advantage of the initiative impulse of highly elastic steam, in contradistinction to the idea of a percussive action, which had some time ago found advocates.—  
*Proc. Ins. Civ. Eng.*

London Athenæum.

*Siemen's Chronometric Governor.*

The action of this governor is so sensitive, that no variation of the speed of an engine, when 40 per cent. of its load is thrown off, can be observed, for the entire change is performed in one-fiftieth of the revolution of the fly-wheel; this change absorbs or adds a portion of the momentum of the pendulum, and slightly alters its arc of vibration, the limit of which is between  $18^{\circ}$  and  $21^{\circ}$ ; and by the laws of pendulous motion, this is shown to effect the number of revolutions to the amount of only 8 per cent. of its velocity, and even that small variation in the extreme position of the pendulum ceases immediately the momentum is restored to its former condition.

Ibid.

*Description of Rowan's Churn, as Manufactured by MR. RICHARD ROBINSON, Lisburn.*

Fig. 1 represents the entire churn when set up for work: it consists of an oval-shaped vessel, divided, in the direction of its longest diameter, into two compartments; in one of which the paddle-wheel works: in the other the butter is collected, as will be better understood by fig. 2, which is a section of it, viewed from above when the cover of the wheel is removed. By turning the paddle wheel (which resembles the one used in the old box-churn) a current of the milk is maintained in the direction of the arrows. As soon as the butter collects on the top of the milk, it is borne along with the current; and by sliding down the sluice (*a*) to the surface of the milk, the butter is intercepted, and accumulates on one side of the sluice; it is then taken out with a small tin scoop, pierced with small holes, through which any milk may pass; but perhaps the accompanying description which

is sent with each churn will tend to explain it better than anything I can write :—

Fig. 1.

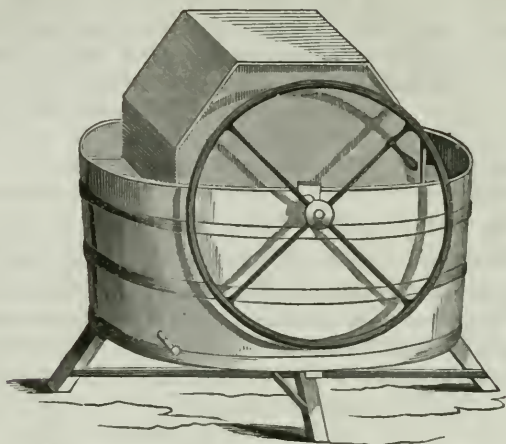
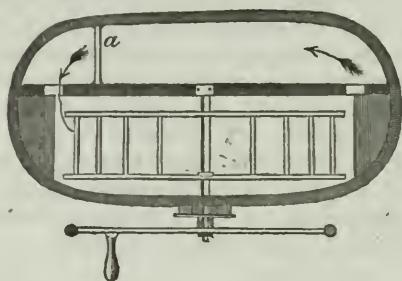


Fig. 2.



“This machine possesses decided advantages over every other hitherto in use, inasmuch as it is more easily worked, and produces more butter of a better quality, than that obtained from, or by, any other churn. As to the superior quality of the butter obtained, it arises partly from the low temperature at which the operation can be performed; for while in other close machines the temperature rises during the operation, in this, the fluid being exposed to the current of air created, the temperature is found to be lower at the latter end than at the beginning of the process; besides, the butter is not so much beaten and toughened by repeatedly passing under the blades as in other machines. It is found, therefore, from all these causes united, that the quality and quantity of the butter are improved, and the labor decidedly lessened. In using a thermometer, this machine possesses superior convenience for making a true observation of the temperature; for, in other machines, the process must be stopped to try the heat; in this, the thermometer may be suspended constantly in the smaller division of the churn, and the temperature accurately observed, at any time, whilst the process of churning is going on.

“The large churns are made, in a most substantial manner, of oak and sycamore, being the best sorts of timber known for the purpose. The smaller sizes are made of strong block tin, with a separate water-case stand, so that all the advantages of the celebrated water-case churns are combined in this new and effective machine.

“The following table is submitted as being convenient for determining the size of churns to be ordered :

Number of cows kept, averaging ten quarts daily.	Quantity of milk col- lected in two days.	If reduced to cream only.	Size of churn required for Milk, using it every two days.	Size required for cream using it every two days.
	quarts.	quarts.	gallons.	gallons.
1	20	2½	8	8
2	40	5	15	—
3	60	7½	24	—
4	80	10	—	—
5	100	12½	30	—
6	120	15	—	—
7	140	17½	36	—
8	160	20	42	—
9	180	22½	48	—
10	200	25	54	15
11	220	27½	60	—
12	240	30	60	—

“This table is only offered as a guide to the sizes of churns requisite, not as containing information on any other point ; for quantities of cream or milk will vary much, according to food and management, &c. It is better, however, to order the churns too large than too small.”

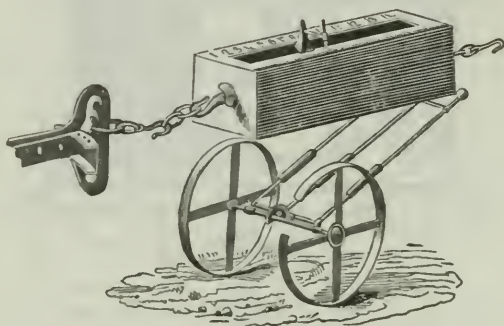
Although good workmanship and neatness of finish is an important feature in every well constructed implement, yet in no department is this more necessary than in those utensils intended for the dairy.

Lond. Farm. Mag.

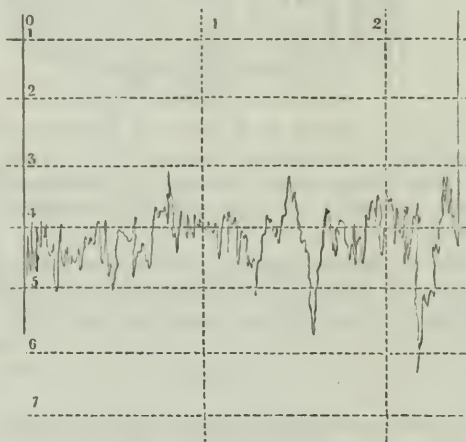
### *Clyburn's Self-Recording Dynamometer.*

The appearance of Clyburn's Dynamometer, as our engraving shows, is that of a small box on wheels. Within the box are a right and left hand spiral spring, placed within each other for economizing space. When the power is applied, the springs are compressed : whilst being compressed, motion is given to a rack and pinion ; and, by a simple mechanical connection, motion from the rack and pinion is communicated to a traversing pencil upon the top of the box ; the pencil there acts upon a roll of paper, marked with lineal divisions,

both lengthways and crossways, each division in the length of the paper indicating a distance of twenty-five yards of ground passed over, and each division of the width 112 pounds of force applied to the instrument. Motion is given to the paper by the pair of wheels which travel over the ground, whilst the pencil is moved backwards and forwards according to the amount of power applied, and thus a drawing is made upon the paper, showing the draught, and the distance traveled over.



The subjoined diagram will describe the nature of the drawing made by the pencil.



The figures down the side, from 0 to 7, represent cwts.; those on the top, distances of twenty-five yards; from which it will be seen that, according to the drawing, the force applied in draught during the fifty yards, averaged rather more than 4 cwt.; because the intersecting line from 4 shows more of the drawing towards the line 5, than it does towards that of the line 3.

*Ibid.*

JOURNAL  
OF  
THE FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
AMERICAN REPERTORY.

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DECEMBER, 1845.

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CIVIL ENGINEERING.

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*Description of the Great Britain Iron Steam Ship, with Screw Propeller; with an Account of the Trial Voyages. By THOMAS RICHARD GUPPY, Esq., C. E.*

(From the Proceedings of the Institution of Civil Engineers.)

(Continued from page 296.)

The steam-engine employed to drive this screw consists of four steam cylinders, each of 38 inches in diameter, by 6 feet stroke, into which steam is admitted by piston valves of 20 inches in diameter.

As it is very troublesome to lift large cylinder covers, manholes are made in them, and in the pistons, so that the bottoms of the cylinders can be easily examined.

The large diameter given to the steam cylinders was purposely with a view to working very expansively, and on the trial recorded, the steam, being at 4 lbs. pressure in the boiler, was throttled on its passage, and cut off by the expansion valve at one-sixth of the stroke, that is, 1 foot from its commencement.

The connecting rods of these engines are applied in pairs to crank pins, at either end of the main shaft, and the same crank pin carries the connecting rod of one air-pump, of the same length of stroke by 45½ inches in diameter.

The air-pump is inserted in the wrought-iron condenser, which receives the steam from the cylinders.

The main shaft is of wrought-iron, 17 feet long by 28 inches in diameter, in the centre, and 24 inches in the bearings, which are 30

inches long ; through this shaft, as through the cranks and crank-pins, a hole is bored and a stream of cold water is constantly injected, which has an important influence in keeping the bearings cool.

Upon this main shaft, is a toothed drum, of 18 feet in diameter, with a face 38 inches in width, around which, and a lesser drum of 6 feet in diameter, placed below it, four sets of pitched chains work ; the motion of which is remarkably smooth and noiseless. Each set of these chains consists of two links and three alternately : the sectional area of the four sets is 24 inches.

The best method of giving the requisite speed to the screw shaft was long under consideration, and the usual means, by gearing, straps, &c., were not overlooked ; but each appeared to have some objectionable quality ; at length Mr. Brunel suggested the pitched chain, which was finally adopted.

These links were very carefully forged, they were then brought to a dull red heat and placed in a proving machine, where they were stretched one-eighth of an inch, and while in that state they were rigidly examined. After boring and planing, they were all finished on one gauging tool and case-hardened.

As the engines are intended to work at 18 revolutions per minute, and the speed is got up at the rate of nearly 2.95 to 1, the screw will then make about 53 revolutions per minute.

The lower shaft, to which the screw is attached, consists of three lengths. On the first, which is 28 feet 3 inches long, by 16 inches diameter in the journals, is fixed the lesser drum, which is 6 feet in diameter, and at the forward end of this is the step, which resists the thrust, or effort, of the screw, which will be presently described.

The second piece is a hollow-wrought iron shaft, 61 feet 8 inches long, and 30 inches in diameter, formed of two courses of plates each three-fourths of an inch thick, riveted together by countersunk rivets  $1\frac{3}{8}$  inch in diameter.

The third piece is 25 feet 6 inches long ; and as the screw has no bearing at its outer end, it is 17 inches in diameter in the journal, just within the stern-post.

The shaft does not rest in the stern-post, but in another bearing, outside of it, and the water is kept out by a packing, composed of leather and copper.

The thrust, or effort, of the screw, is received by a step, composed of a steel-plate 2 feet in diameter, against which a gun-metal plate, of similar diameter, affixed to the heel of the shaft, presses. A stream of water is admitted to a cavity, in the centre of these plates, and very satisfactorily lubricates them.

The cast-iron box of this step is very firmly attached to the frames of the engines, and in fact to the body of the ship, by wrought-iron trussing.

The boilers consist of one outside case 34 feet long, by 31 feet wide, and 21 feet 8 inches high, and this is divided into three distinct boilers, by means of two longitudinal partitions.

They have an apparatus for regulating the discharge of brine, and

also a hot-water jacket, around the lower part of the funnel, into which the feed-water is pumped, and whence it flows into the boilers.

In each boiler there are four furnaces at the after, and four at the forward end; therefore there are twenty-four fires in the whole. Each furnace has its own distinct course of flues, terminating in one take-up in the middle.

The total area of the surface of the grate-bars is 360 square feet.

The total area of furnace surface exposed to the direct action of the fire, is 1248 square feet, and the total areas of the flues are:—

	Square Feet.
Of upper surface, . . . . .	1608
Of side surface, . . . . .	6504
Of bottom surface, . . . . .	1740

When the form of the engines was first decided on, it was intended that the cylinders should be 80 inches in diameter, but they were afterwards increased to 88 inches, with the view of working the steam very expansively and thus obtaining an increase of power at a reduced expenditure of fuel.

As far as can be at present judged, this appears to have succeeded, but in consequence of the rough weather on the voyage round, it was not possible to weigh the coal consumed.

When the *Great Britain* was commenced, the city of Bristol had taken up the subject of widening the dock-gates of the port, with other improvements, so warmly, that no doubt was entertained that, before she should be completed, there would be no difficulty in her going out; accordingly she was designed 5 feet 6 inches wider than the existing locks.

Various causes led to the abandonment, for a time, of these improvements, and the ship, when ready for sea, was not only discovered to be a prisoner, but likely to continue so, in consequence of the personal liability which it was assumed the Dock Company might incur if, by permitting any disturbance of their works, not provided for by Act of Parliament, any injurious consequences should ensue to the port.

This state of affairs lasted for several months, until at length, by an agreement between the two companies, permission was accorded to remove, first so much of the masonry and gates as would allow the ship to pass from the floating harbor into the outer basin, next to restore these, and then to adopt the same course with the gates and one side of the lock communicating with the river Avon.

This was accomplished, and the ship hauled out on the evening of the 11th of December, and at 8 o'clock on the following morning she was towed down the river Avon to Kingroad: the boilers were filled in the progress, the steam was raised, and a trip of a few hours' duration was made, the greatest speed then attained being—

Strokes of the Engine.	Multiplication of the Chain gearing.	Pitch of Propeller.	Feet.	} Velocity of Propeller through the water.
16½	2·948	25 feet =	1197·25	
Speed of the ship,			11 knots =	111·515

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82·10 Slip, or as ·93 to 1·

The next trial was on the 8th January, when a numerous party of proprietors, and several engineers and scientific men were on board; but unfortunately the fog was so dense, that after waiting at anchor for several hours, the pilot, apprehensive of losing sight of the land, reluctantly consented to go a short distance, merely to gratify the visitors. On this occasion the greatest speed of the engines was 18½ strokes, the speed of the ship was 11½ knots, and the slip was 13 per cent.

On the 20th of January a run was taken down the Bristol Channel, nearly to Ilfracombe and back, a distance of 95 knots, without much wind, but in a head swell, and with a balance of about two hours of tide against the ship. This distance was performed in 8 hours and 34 minutes, or at an average rate of upwards of 11 knots.

The greatest rate of engines was 18½ strokes per minute, the steam pressure being 2½ lbs., and the vacuum 26 inches, and cutting off at 18 inches of the stroke; when the ship's speed was 12½ knots, the slip of the screw being 9½ per cent.

Finally, the *Great Britain* quitted the port of Bristol for London on the evening of the 23rd of January.

The masses of cloud which had traversed the sky during the day, and the occasional heavy gusts of wind, indicated the coming of the gale, which was shortly after experienced, as will be observed in the summary of the voyage (for which see next page.)

During this voyage the engines made 52,773 strokes, consequently the distance described by the screw was 639 knots, and the actual distance traversed by the ship, as computed by Captain Hosken, was 567 knots. The ratio of the speed of the ship, to that of the screw, during the entire voyage, was as ·887 to 1; or in other terms, the total slip was 12½ per cent. Considering then, that during the first 20 hours there was a strong gale and a head sea, and also, that in the run from the Downs to Blackwall, there was an exceedingly stiff head gale, while in the intermediate part of the voyage the wind was so light as to be of little service, this may be accounted an exceedingly favorable result.

The balance of tides was also considerably adverse.

The time the ship was under weigh was 59½ hours, so that the average speed was upwards of 9½ knots; and if allowance be made for times when, on account of the bearings becoming warm, the engine went slowly, the average speed may be fairly reckoned at 10 knots per hour.

Owing to the inefficiency of the stokers, the steam was not regularly or well kept up, and the pressure varied from 2 lbs. to 5 lbs., being frequently low. Duffryn coal was used, and all the ashes were burned. The throttle valves were kept more than one-half closed,

and the expansion valves cut off the steam at one-sixth of the stroke, so that the economy of the fuel must have been very considerable; but the men were too feeble to weigh the coal, and the arrangement of the indicators was not so far completed as to enable cards to be taken.

		Revolu- tion of Engines.	Speed of Ship in Knots.	
Thursday,	H. M.			
23rd.	9 30 P.M.	10	6 $\frac{1}{4}$	Passed the Holms. Strong breezes from W.S.W. Hard squalls and rain.
Friday,	4 0 A.M.	9 to	..	Gale, with heavy squalls, and much rain.
24th.	10 0 "	12	..	Abreast of Lundy. Wind shifted to N. N. W., with heavy squalls. High cross sea running. Ship taking in very little water.
	Noon.	13 $\frac{1}{2}$	8 $\frac{1}{2}$	Fresh gale with frequent hard squalls; very heavy cross sea running; ship rolling deep, but easy.
	3 20 P.M.	..	..	Strong ebb tide. A very heavy sea struck the starboard bow, and drove in three 7-inch port-lights, and did some other slight damage to the upper works.
	4 0 "	13 $\frac{1}{2}$	8 $\frac{1}{2}$	Sea going down—ship going much easier. Set jib, square mainsail, and mizen spencer.
	7 40 "	14 $\frac{1}{2}$	9 $\frac{3}{4}$	Sea going down fast; fine clear weather.
	8 45 "	15	10	Passed the Longships. Sea gone down. Sails of little use.
	10 40 "	15 $\frac{3}{4}$	10 $\frac{1}{2}$	Off the Lizard. Sails no use,—fine weather.
Saturday,	2 45 A.M.	..	..	Eddystone light being N. N. E. $\frac{1}{2}$ E. Light air from the southward.
25th.	5 15 "	16	10 $\frac{3}{4}$	Abreast the Start.
	9 45 "	..	..	Off Portland. Set square mainsail and all fore and aft sails.
	12 45 "	16	11 $\frac{1}{4}$	Passed the Needles.
	2 15 P.M.	..	..	Stopped three minutes off Cowes.
	3 40 "	15 $\frac{3}{4}$	10 $\frac{1}{2}$	Passed the Nab light. Fresh breezes from S. W., thick foggy weather and rain.
	9 0 "	16	11 $\frac{1}{4}$	Beachy Head bearing North. In mizen and No. 3 spencer.
	11 30 "	..	..	Abreast Dungeness Light. Fresh breezes and fine weather.
Sunday,	1 45 A.M.	..	..	Came to anchor in the Downs.
26th.	8 11 "	..	..	Weighed anchor and going.
	9 15 "	15 $\frac{3}{4}$	10 $\frac{3}{8}$	Abreast Margate. Stiff gale from W. N. W.
	12 30 P.M.	..	..	Came up with the <i>Waterwitch</i> steamer above the Nore, and passed her at the rate of 3 knots an hour.
	1 47 "	..	..	Very strong gale in the river right ahead. Gravesend Reach full of vessels,—steered in and out between them at full speed.
	3 30 "	..	..	Ran the measured knot in 6' 16", going 16 revolutions against a very stiff head gale.
				Moored at Blackwall.

This account would not be complete without some explanation of the state of the ship, when she encountered the gale on Friday the

24th. The crew of sailors consisted chiefly of that indifferent class usually shipped for short runs, to whom of course the rig of the ship was entirely new. Some of the engineers stood well to their duty, but others, and nearly all the stokers, were completely knocked up with sea-sickness. The deck was encumbered with at least 30 tons to 40 tons of chain cables and materials, and the coal was stowed chiefly in the upper bunkers, for the greater convenience of working it with so few men.

Consequently, with no weight in her bottom, the centre of gravity was raised so high, that the rolling, which was considerable, but very easy, is not surprising.

With the wind ahead, or on either bow, and with a heavy head sea, she steered with the greatest ease and precision, and in the crowded river it was truly surprising how she threaded her way.

When the heavy sea before mentioned struck her it caused no deviation whatever from the uniform motion of the engines, which went on as steadily as if they had been on land, neither was there the slightest yielding in the plummer-blocks, the frame, or in any part of the engines, or the engine-room, which is so riveted together, as to form one united frame.

On several occasions the author watched the screw, and he does not think it ever rose one-half of its diameter out of the water; and standing by the engines during the worst of the gale, he could only observe that there was occasionally a slight acceleration, during perhaps half a revolution, but there never was any check to the uniform rate.

The paper is illustrated by seven drawings and diagrams, Nos. 3778 to 3784, showing longitudinal and transverse sections of the vessel and engines, with an elevation of the screw-propeller and diagrams of its angles of pitch, slip, &c.

To be Continued.

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### *Herron's Patent American Railway Track.*

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Gentlemen.*—I submit for publication in the Journal of the Institute, the accompanying article, and plan, descriptive of my patent railway track, as laid upon the Philadelphia and Reading railroad.

Very respectfully, &c.,

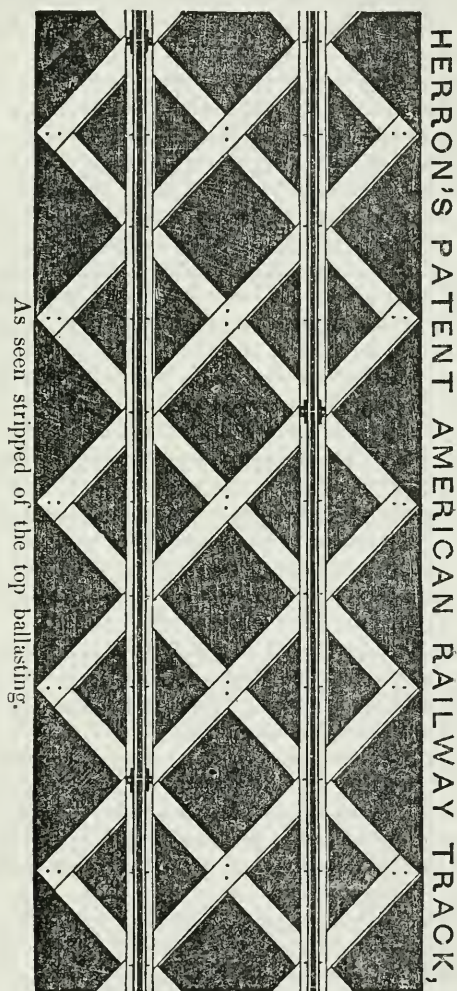
JAS. HERRON, C. E.

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The cut is a plan of the railroad track invented and patented by Mr. James Herron, C. E., as it is laid upon the Philadelphia and Reading railroad, between Valley Forge and Phoenixville, as seen before the trellis foundation was covered with earth.

The trellis, or diagonal sills, represented in white, are 3 inches thick, 8 inches wide, and 14 feet 9 inches long. These sills are of sawed white pine timber. They were laid upon the clay embankments, and in the wet cuts, *without any ballasting under them*; and, it will be seen, that they make an angle of about 45 degrees with the line of the

rails. A second course, of the same sized sills, laid nearly at right angles on the former, make, together, the latticed foundation for supporting the rails, as shown in the cut. These sills are *not* notched into each other where they cross, but are secured together, on the centre line and extremities, by two spikes driven in each crossing.



White pine and hemlock string pieces, 5 inches thick, 8 inches wide, and about 20 feet long, are laid diagonally upon the latticed sills, and are united to each other at their ends by a suitable scarfing. The string-pieces were dressed to a thickness where they rest upon the intersections of the lattice, the inner side being made  $\frac{1}{8}$  of an inch thinner than the outer, for the purpose of inclining the surface of the rails to suit, as nearly as possible, the conical form of the wheels in use

upon the road. The rails, represented by the heavy black lines, have a continuous bearing upon the string-pieces, with which they regularly break joint, while the latter are evenly supported by the strongly combined elastic trellis foundation.

The rails, string-pieces and trellis sills, are secured together upon this track, by  $\frac{3}{4}$  inch screw bolts, two at each intersection of the lattice. And the ends of the rails are joined by chairs of wrought iron, of a new design.

The fastenings used upon this track are more than fifty per cent. heavier than those Mr. H. used upon his Baltimore and Susquehanna track; but, for the generality of railways throughout the United States, the common hook spike fastening would be quite sufficient, and would materially reduce the first cost of the track. Mr. Herron, has, however, devised a more perfect system of adjusting fastenings than any he has hitherto put in practice, by which the rails and string-pieces could be removed, replaced, and adjusted without disturbing the ballasting, or the sub-structure. Those fastenings will, also, afford great additional facility in the taking out and replacing any of the trellis sills that may require it, which can be done on any of his tracks, without stopping the trade of the road, but with the more improved fastenings to the extent of the whole timber structure.

The whole of the timber used in this track underwent an antiseptic process. A solution of the bichloride of mercury being forced into the wood by a pressure of 100 pounds on the inch, the air being exhausted, nearly half a gallon of solution was forced into each cubic foot of timber. The strength of the solution was one pound of sublimate to fifteen gallons of water, with the exception of 9,500 feet, laid between the 28 mile post and Phoenixville, prepared with a solution of only one pound to thirty gallons of water.

The simple soakage of timber in this solution, (Kyan's process) has, almost universally, proved successful, both in the large quantities thus prepared in England, as well as in the more limited application of it, hitherto made in different States of this Union. And, where an occasional piece of timber has been found to decay, in some of the large lots prepared in England, (for as yet, there is no evidence of any timber *prepared with corrosive sublimate*, having rotted in the United States,) there is much reason to suspect that it was owing to decomposition having too far advanced in the heart of the piece at the time it was subjected to the process.

As the penetration by soakage, however, extends but little way below the surface of the timber in the generality of cases, it could not reach, and arrest the decay in progress at the centre, hence the more effectual process of forcing the solution into the body of the timber, to perfect saturation, has been adopted by the British Admiralty, and on some of the more recently constructed railways in England, as well as by Mr. Herron, who is believed to have made the first successful application of it, by hydraulic pressure, in the United States.

Security on this track is nearly perfect, for should an engine, or car, by any means be thrown off the rails, it will not be likely to result in any serious damage, as the trellis sills are covered by the ballasting,

leaving nothing exposed, as the cross sills are, for the wheels to strike against, and thus shatter the carriages. And as the string-pieces and rails are strongly secured, they will serve as guards to keep the carriages from running off the embankments. Cases have occurred, where a car axle broke, and one or more wheels were thrown off the rails, yet the train continued on, in two instances, for more than a mile before the men upon the cars discovered it.

November 15, 1845.—This track has now been opened to the heavy trade one year and five days, during which time, *eight hundred thousand tons*, (of 2,240 lbs.) of coal have rolled over it. The gross tonnage of the coal trade, the cars and engines being added to the above, will make about 1,310,000 tons. And the whole *rolling tonnage*, including freight, passengers, and road materials, probably, 1,400,000 tons. The excellent condition of the track, and the ease of motion with which the cars roll over it, are proverbial.

The quantity and cost of materials and workmanship, per mile of track, were as follows, viz :

8,633 cubic feet (103,600 ft., b. m.) of white pine, at $15\frac{2}{3}$ cents per cubic foot,	\$1,352.51
8,633 cubic feet of timber impregnated with the bichloride of mercury, by hydraulic pressure, at $5\frac{1\frac{2}{3}}{100}$ cents per cubic foot,	442.00
7,794 lbs., of wrought joint chairs, screws, caps, and bolts, at 8 cents,	623.52
7,575 lbs. of hook-headed screw bolts and nuts, $\frac{3}{4}$ inch diameter, at $7\frac{3}{4}$ cents,	587.06
2,000 lbs. of Burden's 7 inch boat spikes, at $5\frac{1}{2}$ cents,	110.00
2,143 lbs. of cast-iron washers for bolts, at 3 cents,	64.29
<hr/>	
Cost of materials, exclusive of rails,	\$3,179.38
93 tons of H rails, 59.2 lbs. per yard of bar, at \$60 per ton,	5,580.00
Workmanship, constructing and laying track, about	1,000.00
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Cost of *one mile* of Herron's patent track, No. 1, as laid on the Reading railroad, \$9,759.38

The above account, does not, of course, include the cost of widening the cuts and embankments, removal of slips, loose stone, solid rock, and ditching; nor the distribution of materials, straightening of damaged iron, cost of hydraulic Kyanizing apparatus, timber and other materials left and since used upon other parts of the road, &c.

When spikes are used to secure the rails, instead of screw bolts, the cost will be very considerably reduced; and as timber may generally be had at one third less than the above price, and as it may be more cheaply preserved with the chloride of zinc, the cost of No. 2 track, laid with heavy iron, will be from seven to eight thousand dollars per mile.

For the purpose of extending the benefits of this improvement as widely as possible, Mr. Herron has determined to render his patent charge merely nominal, by merging it in the cost of construction, while the latter will be fixed, in accordance with the usual prices, at

a fair moderate estimate for mechanical labor; and it will be found by comparison, to be much lower than the prices that have been usually paid for the better description of tracks in use. Thus, for the construction of No. 1 track, with the screw bolt fastenings, and all his more recent improvements, at the present price of labor, he will charge one thousand dollars per mile.

No. 2 track, under the same circumstances, will be constructed for eight hundred dollars per mile.

These prices may have to be slightly increased in the southern States, or wherever labor is high.

Companies will thus get the benefit of Mr. H.'s engineering experience and skill in perfecting their road way superstructure, while it will be clearly to his interest to execute the work in the most substantial and faithful manner, that will make it, in truth, a *permanent railway*.

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### *Canal Steam Navigation.*

On the 22nd ult., a trial was made on the Grand Junction Canal, of a small experimental steamer fitted with submerged propellers (not screws) on a plan recently patented by Captain W. H. Taylor. It was witnessed by the chairman and several of the directors of that navigation, and gave, we understand, the most unqualified satisfaction. No perceptible wave was produced by the boat when towing at the rate of four miles an hour, which is as great a speed as is required for the goods traffic on canals. We had ourselves, not long ago, an opportunity of seeing this boat at work on another canal, and were much struck with the absence of every external sign of the motive-power by which it was propelled. Not the slightest swell by which injury can be done to the banks, but an air bubble or two at the sides, which vanished as soon as generated. The success of this invention has led to the formation of an association for carrying goods by steam on the Grand Junction and other canals in connection with it; and so far as all the heavier kinds of goods are concerned, there can be little doubt of the canals being at length enabled, by this means, to compete effectually with their powerful railway rivals. In an early number we shall give a full description of Captain Taylor's invention.

Lond. Mec. Mag.

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### *Lighting Mines by Electricity.*

A letter was read before the Paris Academy of Sciences, September 15th, 1842, from M. de la Rive, on the possibility of rendering the electrical light available for the use of workmen in mines. This gentleman states that five or six elements of a pile of copper, and an amalgam of potassium, sufficed to render incandescent two cones of charcoal inclosed in a small glass globe.

London Athenæum.

## FRANKLIN INSTITUTE.

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*Fifteenth Exhibition of American Manufactures, held in the city of Philadelphia, from the 21st of October to the 1st of November, inclusive, 1845, by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts.*

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ADDRESS OF JOHN WIEGAND, ESQ.,

*Chairman of the Committee on Exhibitions. Delivered on announcing the Premiums awarded.*

LADIES AND GENTLEMEN:—Our business here this evening is simply to announce the awards which the Committee on Exhibitions have had the pleasure to make. We shall depart from our usual course on this occasion in not giving a detailed report of the merits of this exhibition of American manufactures.

The detailed report, from its great length, would occupy more time in reading it than we have at our command, or than this company could afford to give. We shall therefore have it published in such form as will render it accessible to all who take an interest in American industry and skill. We cannot omit to express our regret that many, and some among the most beautiful specimens of workmanship in the exhibition, were deposited too late, according to our published rules, to receive any awards.

We feel also bound on this occasion to correct an erroneous impression existing among some of the depositors, and visitors, that the Committee on Exhibitions are the exclusive judges of the merits of the articles deposited. The facts in relation to this matter are briefly these:—The articles deposited for exhibition are divided (this year) into thirty-six classes; and upon each class of goods a committee of judges is appointed by the committee on exhibitions, who are selected exclusively for their knowledge and experience in the particular branch of business committed to them; they are selected without reference to their being members of the Franklin Institute, and with the most guarded care that they are in no wise connected with any of the depositors whose articles they are called upon to examine. It is upon the reports which these judges return, that the committee on exhibitions make their awards. We wish it distinctly understood, that the committee on exhibitions reserve to themselves the right, and they always exercise it, of reviewing, and, when proper, of revising the reports of the judges. The reasons for this may be found in our published rules for governing the exhibition. We also desire to have it known, that the highest award which the Committee on Exhibitions can make, is the Silver Medal—the award of the Gold Medal can only be made by the vote of the Institute. To the Judges, and to the gentlemen of the Committee of Arrangements, the Committee on Exhibitions take this public opportunity of returning the thanks of the Institute.

Before announcing the awards, we will only add, that if any article worthy of an award has been omitted, by promptly pointing it out to the Committee, the omission will be corrected, and the award published immediately, before the delivery of the closing address to-morrow evening.

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#### REPORT OF THE COMMITTEE ON EXHIBITIONS.

In presenting their Report on the Fifteenth Exhibition of American Manufactures, held under the direction of the Franklin Institute, the Committee on Exhibitions feel that they have renewed cause for congratulating the friends of American Industry upon the result. They are truly gratified, on this occasion, to notice the steady march of improvement in almost every branch of our Home Productions. The skilful and persevering efforts of our Manufacturers, Mechanics, and Artisans have been crowned with such success as promises, very shortly, to render us independent of foreign workshops, for almost every article made for purposes of utility, convenience or luxury.

The principal object of the Institute in holding these Exhibitions, is to enlarge and continue the impulse already given to improvement in the Arts and Manufactures; the evidence of which is presented, from year to year, in the great number of newly invented or improved articles;—in fabrics of finer finish and lower prices, produced by the application of new machinery or improved processes.

Industry is the true source of wealth. Capital, judiciously employed in manufacturing, creates wealth by encouraging industry and enterprise, and when money is thus invested with a view to the employment of labor, this very labor creates additional wealth. No one need then be idle, and the mechanic and the laborer, with ordinary prudence, may enjoy not only the necessities but many of the luxuries of life. By the increase of manufacturing establishments, employment is not only afforded to men and women, but a sure means is offered of training youth to industry, and keeping them from idleness, mischief and vice. Many parts of New England present pleasing examples of the comfort, morality and order, as well as the decency of appearance and manners, which may exist among a well regulated and intelligent manufacturing community,—the more pleasing when contrasted with the vicious habits and turbulent disposition manifested by the idle and dissolute portion of the population of some of our large cities.

If, therefore, our capitalists, instead of dabbling in stocks, and encouraging wild or useless projects of speculation, would invest their money so as to encourage labor,—they would not only insure a profitable return, but would likewise enjoy the high satisfaction of promoting the real prosperity of our country by encouraging and adding to its productive industry, by giving employment to, and producing a better state of morals and conduct among, a class of society where idleness is sure to produce mischief and crime.

In the arrangement of the Exhibition, the Committee endeavored to pursue such a course as they judged best calculated to ensure gen-

eral satisfaction, and to afford the depositors the best opportunity of a favorable location, according to the kind of articles exhibited. Yet so extensive was the collection, that, notwithstanding the immense size of the rooms on both floors of the Museum Building, including the galleries, sufficient space was scarcely afforded. Almost every department of productive industry was represented. The manufactures of metal, from a steam engine down to a watch spring and a needle were there;—so also were the fabrics of the loom, the factory, the workshop, and the laboratory:—cottons, woollens, silks, glass, leather, paper—and the thousand useful preparations and modifications which art and skill produce from rough material or unconverted masses. This vast variety of useful and ornamental articles, the fruits of skill, genius, and invention, were generally of a quality and workmanship honorable to the producers, and creditable to the mechanics of our country.

In the award of premiums, it has been the desire of the Committee to adhere strictly to the rules prescribed. They are fully aware that the closest scrutiny and the most rigid impartiality are necessary in this department of their duties, and that even these will not give satisfaction to all. Disappointment will be felt, and offence taken, whatever diligence may have been used to avoid all occasion for either, and however justly and impartially the awards may have been made. In a collection of such immense extent, and comprising so vast a variety of objects, it is scarcely possible that some should not be overlooked, or otherwise fail to receive the requisite attention.

Competent and disinterested persons were selected as judges on each separate class of goods deposited—from whose reports the following detailed abstract of awards, observations and notices is chiefly compiled.

### I.—*Cotton Goods.*

The Committee of Judges on Cotton Goods, in their report, state that they have been guided solely by their desire to do justice to all parties, and to further, as far as in them lay, the progress of the Industrial Arts in the extension of the manufacture of the many articles of daily use to which their attention has been directed. Believing, as they do, that the prosperity of our whole country depends, to a very great extent, on the employment and increase of *Home Labor* in the production of the various commodities of taste, as well as of necessity, that make up the larger amount of the business transactions of the country, they are always gratified at any exhibition of American skill tending to this result.

They regret that the Exhibition of the present season does not offer a greater variety of articles for competition, which they can scarcely account for but by the supposition that a disinclination exists among many manufacturers to make too public their improvements in design, or their novelties in invention; fearing, perhaps, that a too early publication of them might interfere with that full compensation for their skill and enterprise to which they, no doubt, feel themselves entitled. Another reason may, perhaps, be found in the fact that the

manufacture of a large portion of the cotton fabrics of the country is in an unusually flourishing condition, allowing little time to any thing but the pressing demands of the business. The committee hope that the future exhibitions of this branch of American Industry will be more commensurate with its importance than they have hitherto been.

No. 3, cambric long cloth, manufactured at James' steam mill, Newburyport, Mass., deposited by C. W. Churchman, is a beautiful article, and the finest of the kind we have ever seen of American fabric. It is remarkable for the delicacy and softness of the finish, as well as for the fineness of the thread and its even texture. More of that firmness and body, so requisite in long cloths, would be, however, desirable. To this specimen is awarded the First Premium.

Cambric muslins, from the same factory, are superior in fineness to any American cambrics that we have seen; but have too hard a finish, and would have been decidedly better had they been made more pliant. They are, however, worthy of the Second Premium.

Nos. 38 and 39, printed cottons from the American print works, Fall River, Mass., deposited by David S. Brown & Co., are noticed for great beauty in the designs, richness and agreeable effect in the combinations, and a delicacy and exactness in the execution that decidedly take the lead this season. The First Premium.

No. 72, long cloth shirting, (extra) from the New York mills, deposited by John W. Downing, is a very superior article, highly creditable to the manufacturers, Messrs. Marshall & Wolcott. It is recommended for its beauty and softness of finish, evenness of thread, and the firmness and solidity of its texture. The First Premium.

No. 105, mousselines de laine, printed by J. Dunnell & Co., deposited by Fales, Lothrop & Co., have a very satisfactory effect in their combinations, and are noticed for a commendable skill in the execution. This is an important article, as a large amount is annually imported from abroad. We award the First Premium.

No. 36, striped chintzes by I. P. Wendell & Co., Philadelphia county, are remarkable for the pleasing effect produced by the novelty and skill of the combinations: at a short distance, they much resemble a striped silk. The committee notice that these goods are printed on the first cloths made at the Washington factory, Gloucester, N. J., and it gives us pleasure to bear witness to their superiority. For the printing, we award the Second Premium.

No. 74, corded skirts, by Marshall & Wolcott, New York Mills, deposited by John W. Downing & Co., are an improved article in style and finish, and deserve the Second Premium.

Nos. 113 and 114, gingham and checks made by Wm. Smith, Philadelphia, deposited by Temple, Barker & Evans, are superior goods in their line, and deserve the Second Premium.

No. 136, colored cambrics, by Jones, Hoppin & Co., Philadelphia. These goods show considerable improvement in style and finish, as well as in the brilliancy and purity of the colors. Second Premium.

No. 2, cotton fringe, by C. Link, Philadelphia, deposited by W. P. Hollingsworth. This article is of good texture and style. It is not

extensively made in this country, and is imported to a considerable amount. The maker deserves the Third Premium.

No. 40, furniture prints, from the American Print Works, Fall River, Mass., deposited by D. S. Brown & Co., are an improvement as regards boldness of design and a happy effect of color. They merit the Third Premium.

No. 75, cotton cassimeres, by Marshall & Wolcott, New York Mills, deposited by John W. Downing, of neat fabric and very pleasing style, are considered worthy of the Third Premium.

No. 154, cotton prints, deposited by Dunbar & Welling, were brought too late for competition; the judges' lists having been closed at 10 o'clock on Tuesday.

The Committee remark that several lots of goods are deposited in the names of the persons having them on sale; but who do not appear to be the agents of the manufacturers. This seems to be much like an advertisement, and not in accordance with the objects of the Institute.

## II.—*Woolen Goods.*

The display of Woolens, from its extent, variety of style, and general excellence, is highly interesting,—showing the rapid progress of our enterprising manufacturers in this important branch of our home industry. American citizens need be no longer dependent upon foreign looms for suits of elegant and substantial clothing. The judges of this branch of the exhibition make the following awards:

No. 4, 6-4 tufted, plaid, and striped cloak linings, made by Gilbert & Stevens, of Ware, Mass., deposited by Stone, Slade & Farnham, of superior style and make, are deemed worthy of the First Premium.

No. 23 to 28, super fancy cassimeres, manufactured by W. & D. D. Farnum, Waterford, Mass., deposited by David S. Brown & Co. These cassimeres the judges consider very superior, and the best exhibited. The material appears to be of the best quality, and the workmanship of a high and tasteful order. They award the First Premium;—but the Committee on Exhibitions, upon review and further consideration, have resolved to recommend to the Institute to award to these goods a Gold medal of such description and character as may be determined by the Institute.

Nos. 31 and 120, wool black cloths, by W. & D. D. Farnum, Waterford, Mass., deposited by David S. Brown & Co., and by Ellison & Peters. These cloths the judges consider as the best exhibited. The superior quality of the wool, and the beautiful color and finish, give evidence of great perfection and reflect credit upon the manufacturers and the country. They eminently merit the First Premium.

No. 88, fancy cassimeres by Edward Harris, Woonsocket, R. I., deposited by W. R. Hanson & Brother. The superior style and perfect make of these cassimeres the judges consider deserving of the First Premium.

No. 90, fancy colored cloths, manufactured by Samuel Slater & Sons, deposited by W. R. Hanson & Brother. The superior finish and perfect color of these cloths justly entitle the makers to the First Premium.

Nos. 21 and 22, embossed table and piano covers, by Duncan & Cunningham, of Belleville, N. J., deposited by D. S. Brown & Co., exhibit great perfection in this branch of manufacture. Their tasteful style and elegance of pattern are worthy of the First Premium.

No. 122, fancy cassimeres, by Gilbert & Stevens, of Ware, Mass., deposited by Stone, Slade & Farnham. The style and pattern of these goods are deemed ordinary by the judges, yet they consider that their superior wool and perfect make, entitle the manufacturers to the First Premium.

Nos. 14 and 116, fancy mixed satinets, by the Franklin Manufacturing Company, Rockville, Conn., deposited by F. D. Dougherty and by Dulles, Aertsen & Fisher. A good article, creditable to the makers, and deserving the Third Premium.

No. 29, cloth-finished striped cassimeres, by W. & D. D. Farnum, Waterford, Mass., deposited by David S. Brown & Co. A good article, well finished, and worthy of the Third Premium.

No. 91, wool and piece-dyed beaver cloths, by the Hamilton Manufacturing Company, deposited by W. R. Hanson & Brother, well made and good finish. The Third Premium.

Nos. 92 and 160, fancy cassimeres, by J. & J. Eddy, deposited by W. R. Hanson & Brother, give evidence of good taste in the style, &c., and merit the Third Premium.

Nos. 19 and 20, embroidered and plaid woolen shawls, by Duncan & Cunningham, Belleville, N. J., deposited by D. S. Brown & Co. These goods the judges regard as very superior in style, particularly the embroidery; but as showing no improvement on similar articles formerly exhibited. They are awarded the Third Premium.

No. 124, white flannels, by Gilbert & Stevens, of Ware, Mass., deposited by Stone, Slade & Farnham. Superior goods, of good width and excellent material: the best specimen exhibited, and worthy of the Third Premium.

No. 68, woolen hoods, made by John Jones, with machinery; deposited by McDowell & Day, a beautiful article, deserving of the Third Premium.

The judges also notice as good articles, No. 8, drab satinet, by the Washington Company, Conn., deposited by Haas & Hollingsworth; and No. 89 fancy cassimeres, by Wethered & Brothers, Md., deposited by W. R. Hanson & Brother.

### III.—*Carpets and Oil Cloths.*

The assortment of goods deposited in this department of the Exhibition, was not extensive, and might be greatly increased by our manufacturers. The samples exhibited were generally good, and creditable to the makers. The following awards were made by the judges.

No. 318, brussels Carpet, by John Rosencrantz, of Philadelphia, to which is awarded the First Premium.

No. 305, imitation mahogany oil cloth, by O. Brackett, Cincinnati, Ohio, deposited by Jacob M. Ellis; the Second Premium.

Nos. 304 and 457, oil cloth, by C. M. Bailey, Winthrop, Maine, the Third Premium.

No. 306, oil cloth bureau and table covers, by A. Johnson, Cincinnati, deposited by Jacob M. Ellis, the Third Premium.

No. 358, oil cloth, by Rice & Sampson, Hallowell, Maine, deposited by L. H. Grover, the Third Premium.

#### IV.—*Silk Goods.*

The silks exhibited are very good, and fully sustained the previously acquired reputation of our American Silk manufacture.

No. 46, silk cravats, by B. & A. Hooley, of Philadelphia. Very soft and well woven : made of American silk, except the chain, which is spun by the manufacturer from Chinese raw silk. Considered worthy of the First Premium.

No. 18, silk embroidered shawls, by Duncan & Cunningham, Belleville, N. J., deposited by David S. Brown & Co. Very handsome specimens, to which we award the Third Premium.

No. 42, silk twist, by Jos. G. Gurney & Co., Newark, N. J., deposited by Frederick Thorspecken. A very good article, which merits the Second Premium.

No. 69, embossed silks, by Caleb S. Marshall, of Philadelphia. A remarkably good specimen of embossing, for which is awarded the Second Premium.

No. 103, mohair fringe, by J. C. Dobleman, Philadelphia, deserves the Third Premium.

The floss and sewing silks exhibited, are noticed by the judges as being of good quality.

#### V.—*Iron and Steel.*

This staple production of our own State, was creditably represented in the Exhibition, and was carefully examined by competent and skilful judges.

No. 1502, a bar of railroad iron, made by the Montour Iron Company, at Danville, Pennsylvania, Henry Brevoort, Superintendent, and deposited by John L. Linton, Secretary of the Lancaster and Harrisburg R. R. Co. This is an H rail, 18 feet in length, and weighing 50 lbs. per yard ; of good form, well rolled, and handsomely finished. It is made from ore mined in the vicinity of Danville, and from the smelting of the ore to the finishing of the bar, Anthracite coal has been the only fuel employed. This result is highly creditable to the manufacturers. Railroad iron, made with anthracite coal, is a new article, of very great importance to the manufacturing prosperity of Pennsylvania ; and as the production of good edge rails is one of the highest branches of the art of rolling iron, this specimen is considered worthy of the highest honor we can award, the First Premium.

The Committee on Exhibitions, however, in consideration of the great importance to our State, of manufacturing Railroad iron entirely with Anthracite coal, have resolved to refer this subject to the Institute, for the determination of such higher award as may be judged proper.

Another H rail of similar size to the foregoing, made of Coke iron, by the Mount Savage Iron Company in Maryland, is a creditable spe-

cimen. This Company received a medal at the last exhibition for a bridge rail of 40 lbs. per yard, which has been deposited with the Franklin Institute.

Large sums have been invested, during the last three years, in extensive rolling mills, and with the protection now afforded to American rolled iron, the manufacturers in our country are rapidly becoming able to supply the demand for home consumption at reasonable prices.

In the manufacture of bar-iron, both hammered and rolled, it is highly important that each manufacturer should endeavor to attain uniformity of quality in every article. It is too often the case that while some bars of a lot may be decidedly good, others will be much inferior, which is owing to a want of care in working. By attaining a reputation for furnishing an article which may always be depended upon as equal to sample, and which will not disappoint the consumer, the manufacturer will consult his own best interests, and will be sure to be well rewarded for it in the end.

No. 1624, a lot of hammered iron, of various sizes, deposited by Morris & Jones. The samples from Pine and Castle Fin forges are both of very good quality: one bar from Pine forge is considered to be excellent, and entitled to the Third Premium.

The judges notice with approbation No. 1624, rolled iron from the Colemanville and Howard Works—also, No. 1644, rolled iron and slit rods, from Valentine & Thomas, deposited by Isaac Miller. No. 1676, a lot of iron of good quality, was deposited by Hunt, Brown & Hunt, but came too late for competition. A bar of hammered iron from the Weymouth Works, made by S. Colwell, was considered of superior quality.

No. 1593, a plate of boiler iron, rolled by Whitaker, Garrett & Hewes, at Elk Works, Md., and deposited by M. D. Mahony, is of extraordinary size, being 53 by 94 inches, and  $\frac{3}{8}$  thick, weighing 504 lbs. It is well rolled, and worthy of the Third Premium.

No. 1544, two plates of boiler iron, rolled by Rowland & Hunt, deposited by Morris & Jones, are fine specimens of rolling. They are  $\frac{3}{8}$  thick—one being 42 by 93 inches, weighing 379 lbs., and the other 126 by 32 inches, 373 lbs. There is also a good sheet by Forsyth & Son, 108 by 26 inches.

We are pleased to observe an evident improvement in the manufacture of boiler iron, both with regard to the size of the plates and the style in which they are rolled.

No. 1504, a case of Wood's sheet iron, in imitation of the Russian, maintains the reputation of a valuable article which has come into extensive use.

No. 1573, a bundle of common sheet iron, by A. Wood & Brothers, Philadelphia, is a good article.

No. 1513, a roll of bright iron wire, in a single piece, upwards of 4 miles in length, drawn by John Holt, of South Easton, Pennsylvania, and made of iron from Buffalo, Rockbridge Co., Va., is a beautiful specimen, and deserving of the First Premium.

No. 1579, specimens of blistered steel, by John Robbins, Jr., of Ken-

sington. One of these marked (B) from Swedish iron, is of very good quality, and superior to any presented at former exhibitions. It merits the Third Premium.

Other specimens, from the same lot, with different marks, are favorably mentioned by the judges. One from American refined iron is noticed as not being equal in quality to the best specimens made from Swedish iron.

Improvements in the manufacture of steel from American iron are still very desirable.

#### VI.—*Umbrellas, &c.*

The display of articles in this line was rather limited, but are all spoken of by the judges as being worthy of commendation.

No. 95, silk umbrellas, by Wm. A. Drown, Philadelphia, are wholly of American material, and mentioned by the judges as being better than any imported article of the kind that they have ever seen. We award to the maker the First Premium.

No. 104, parasols, by Asch & Pincus, Philadelphia, are highly creditable for their superior finish, and worthy of the Second Premium.

No. 17, umbrella and parasol stretchers, by Barnhurst & Sons, Philadelphia, are extremely well made, and deserve the Third Premium.

No. 107, umbrella mountings, by Covert & Homer, are elegantly finished, and merit the Third Premium.

No. 94, gingham umbrellas—No. 96, fringe parasolets, and No. 97, parasols; all by Wm. A. Drown, are very creditable specimens of manufacture.

#### VII.—*Lamps and Gas Fixtures.*

The judges appointed to examine this branch of the exhibition, report that the display of lamps is not so extensive as on some previous occasions; but the former general character of excellence is fully sustained. They have made the following awards.

No. 1264, an extensive assortment of lamps and chandeliers, by Cornelius & Co., of Philadelphia, the First Premium.

No. 1276, chandelier, solar lard lamps, &c., by Ellis S. Archer, Philadelphia. The chandelier is in very good taste, and the lamps neatly constructed. They merit the Second Premium.

No. 1261, a collection of useful lard lamps, manufactured by J. W. Henry, Philadelphia, the Third Premium.

No. 1292, lard lamps, by Filley & Kisterbock, Philadelphia, the Third Premium.

No. 1237, lard lamps, by Wm. Miller, the Third Premium.

The parabolic reflector, No. 1267, is inferior in finish to some which have been formerly exhibited.

No. 1315, lamps and chandeliers, by M. B. Dyott, were not deposited in time.

In the awards for lamps, the merit of the workmanship and general appearance were chiefly considered. The respective merits of the inventions should be decided upon by the Committee on Science and

Arts of the Institute, by whom they will be examined if the makers signify their desire to have it done.

### VIII.—*Hardware and Cutlery.*

The extensive assortment of useful and ornamental articles in this department, added much interest to the exhibition, and from their general excellence reflect much credit upon the makers. It is proper to observe that most of the articles exhibited, were taken from the shelves of the manufacturers, or their agents;—indeed the Committee are not aware of a single specimen having been made expressly for the exhibition. The very high degree of perfection to which this branch of industry has attained among us, is highly creditable to American skill. Most of the articles exhibited will compare advantageously with the same description of goods of the best European make. Nothing is wanting to establish this branch of industry on a firm basis, but the patronage of a discriminating public.

No. 633, pocket and pen knives, by W. Wild, N. York, deposited by Moore, Heyl & Co. These rank among the best specimens of cutlery in the exhibition. They are all of good proportions and strength, and, but for a slight defect in the grinding and polishing of some of the blades, they (especially the “Wharnclyff” and “Congress” knives) will bear the closest comparison with similar articles from the best English makers. They deserve the First Premium.

No. 667, fast cast iron butt hinges, by Morris, Tasker & Morris, Philadelphia. These were carefully compared with similar articles from other celebrated makers, and for general excellence, the judges think them the best exhibited. As this is comparatively a new branch of business, and until recently enjoyed by foreign manufacturers, the Committee think the makers entitled to the First Premium.

No. 706, drilled eye needles, by Hill & Chamberlin, Philadelphia. These needles afforded the judges great satisfaction. They were carefully compared with the best English make and found to be equally good. As they are drilled, polished and finished in this country, the Committee think they may with propriety be awarded the First Premium.

No. 614, britannia ware, by Hall, Boardman & Co., Philadelphia. These are well made, of fine and smooth surface, but the forms or patterns might, perhaps, be improved. For the general excellence of the workmanship the makers are entitled to the Second Premium.

No. 661, pen and pocket knives, by the Waterville Manufacturing Company, Waterbury, Conn., deposited by R. Carter. These appear to be substantially made, the patterns are neat, and the grinding and polishing of the blades very good. A want of better finish in the handles alone rendered them inferior to specimens exhibited by other makers. They are deemed worthy of the Second Premium.

No. 606, clock and watch springs, by Prenot & Gertin, Philadelphia. This is a new article in our exhibitions, though we learn that they have been for some years manufactured in the United States, and that they are preferred by some watch makers to the best imported. The present specimens have been examined by experienced watch makers,

and pronounced to be a good article. The makers deserve the Third Premium.

No. 615, files, by W. G. Greaves, deposited by J. A. Norris. Remarkably well made in every respect. After a close inspection and comparison with others exhibited, the judges award them the Third Premium.

Nos. 617 and 715, planes, by E. W. Carpenter, of Lancaster, Pennsylvania. A good and well-made article, for which the maker is entitled to the Third Premium.

No. 624, augers, by Sanford, Newton & Co., Meriden, Conn., deposited by Heaton & Denckla. These are a very superior made article in every respect, and merit the award of the First Premium.

No. 626, hand cards, by Wm. Whittemore & Co., Boston, deposited by Heaton & Denckla. These appear to be substantial and well made of good materials. We award the Third Premium.

No. 627, table cutlery, by G. W. Bartholomew, Berlin, Conn., deposited by Heaton & Denckla. Very well made, and a close imitation of the same description of English goods. The Third Premium.

No. 631, hand cards, by Prentiss & Brother, Philadelphia. Equal in quality to any exhibited. The makers deserve the Third Premium.

No. 650, planes, by Colton & Sheneman, Philadelphia. Very creditable specimens of the makers' art, and worthy of the Third Premium.

No. 653, Pennsylvania axes, by Sharpless & Maris, Delaware county, Pa., deposited by J. M. Maris. These are beautiful specimens of the makers' skill, being of good form and strength, the surface free from imperfections and highly polished. The Third Premium.

No. 656, currier's tools, by Hunt, Woodward & Conner, N. York, deposited by Pugh Madeira. These tools appear to be substantially made, though there is not much in their finish worthy of commendation. This being rather a new branch of business, we award the Third Premium.

No. 671, shuttles, by Ellis Jackson, Philadelphia, neat and well made articles, entitling the manufacturer to the Third Premium.

No. 678, brass kettles, by the Wolcottville Brass Company, Conn. These are the "brass battery wash kettle" and a good imitation of, and substitute for, the imported article. The Third Premium.

No. 679, stocks and dies, by J. M. King, Waterford, N. Y., deposited by Curtis & Hand. Well made tools in every respect, and deserving of the Third Premium.

No. 684, cast iron bolts, by T. F. Stanley, New Britain, Conn., deposited by Curtis & Hand. A substantial and beautiful article, which must supersede the old flimsy wrought bolts. The Third Premium.

No. 695, planes, by John Coulter, Philadelphia. Creditable tools, made for use and not for exhibition; they are equal to any in the collection, and are worthy of the Third Premium.

No. 1288, patent locks, by Littlefield, Patrick & Shannon. These maintain the high character obtained at former exhibitions. They appear to possess the great requisites for ordinary use, simplicity and durability. For neatness and general excellence, they at least deserve the Third Premium.

No. 604, rasps and files, by Geo. Machin, Philadelphia; No. 610, tailors' shears, by R. Heinisch, Newark, N. J.; No. 611, iron castings, by Savery & Co., Philadelphia; No. 623, hinges, by the N. E. Butt Company; No. 674, hinges, by the American Butt Company; and No. 681, screws, by the N. E. Screw Company, are all very excellent articles, and fully sustain the reputation of their makers, who have received premiums at former exhibitions; but which do not evince sufficient improvement to justify new awards.

No. 662, a card of iron castings, by Morris, Tasker & Morris. The specimen of casting which forms the border of this card is highly creditable, being sharp and smooth; but we would suggest that figures less faulty than those in the body of the card could be as easily cast, and would produce a more agreeable effect.

No. 691, samples of metal buttons, plain and embossed, by Wadhams & Co., Wolcottville, Conn., deposited by S. Byerly & Co. Nos. 704 and 705, gilt and embossed buttons, by Scovill & Co., Waterbury, Conn., deposited by R. F. Chamberlain & Co. The workmanship on these buttons is good, and in most respects highly creditable to the makers. It is, however, a subject of regret that in preparing some of the dies for the embossed work, more perfect figures were not adopted.

Of the following articles the judges speak in terms of approbation.

No. 602, shovels and spades, by T. C. Wood, Philadelphia. No. 605, shovels, by Jas. Richards, Philadelphia. 608 and 609, chains, by Wm. Whitehouse, Philadelphia. 613, mortise lock, by R. Kinsley, Springfield, Mass. 616, hammers, hatchets and pincers, by C. Hammond, Cheltenham, Pa.; hay forks, by N. Harper, Philadelphia. 620, guns and pistols, by John Krider, Philadelphia. 637, ditto, by E. K. Tryon, Philadelphia. 625, stair rods, by L. P. Lee, New Britain, Conn. 627, small files, W. & J. Davis, N. Y. 627, latches, by Blake & Brothers, New Haven, Conn.: the last three numbers deposited by Heaton & Denckla. 646 and 692, screw wrenches, by S. Merrick, Springfield, Mass., deposited by Foote & Thompson, also by Curtis & Hand. 648, iron washers and fine wooden combs, deposited by Foote & Thompson. 649, Butt hinges, by Adams & Co., Pittsburgh. 652, brass furniture, F. Gordon & Son, Philadelphia. 665, stair rods, by Edward Jones, Philadelphia. 673, patent vice, by C. Parker, Meriden, Conn. 680, plane irons, by W. Field, R. I. 682, locks and latches by Pierpont, Mallery & Co., New Haven, Conn. 682, scythes, by Darling, Mass. 686, augers, scissors and shoe knives, by various makers; the last five numbers deposited by Curtis & Hand. 687, annealed iron castings for locks, by Cyrus Mowville, N. J., deposited by J. B. Shannon. 689, saws, by E. & J. Turner, Philadelphia. 707, locks and leaf holders, by Joseph Nock, Philadelphia.

It is to be regretted, that many beautiful specimens in this department came too late to be submitted to the inspection of the judges. Among them may be mentioned: No. 719, cleavers, by John Beaty; 710, plated butt hinges, by C. Cowdrick; 712, carpenters' rules, by W. Thrall, Conn.; 726, lock furniture, by Hicks Manufacturing Company, Conn.; 725, carpenters' rules, by H. Chapin, Conn.; 731, Augers, by John Conrad & Son, Montgomery county, Pa.; 720, iron squares

and trowels, deposited by Heaton & Denckla; 724, circular and mill saws, by J. Paul, Philadelphia; 716, lock, by Joseph Nock; 736, shovel, tongs, etc., by J. D. Byrne, Trenton, N. J.; 730, axes, hatchets, etc., by Madeira & Humphreys, Chambersburg, Pa.; 723, scythes, by Mansfield & Holman, Smithfield, R. I.

#### IX.—*Saddlery, Harness, and Trunks*

The articles in this department, though possessing no marked superiority over those of former exhibitions, were generally well made, and reflected credit upon the manufacturers.

No. 380, a set of double harness, by Robert Carey, of Philadelphia, is new and tasteful in its ornaments, and particularly neat and well finished. It sustains the high character of the maker, to whom is awarded the First Premium.

No. 323, whips, by Pearson & Sallada, Philadelphia, are very neat and handsome articles, and are deemed worthy of the Second Premium.

No. 344, saddle and military equipments, by S. A. Hagner, Philadelphia. Creditable for taste and general arrangement, as well as for excellence of workmanship. It merits the Third Premium.

The judges also notice with approbation, No. 301, bridle bits, by Benjamin Welsh, Philadelphia; No. 378, trunks, by A. L. Hickey & Co.; No. 343, trunk and valise, by John F. Unruh; No. 331, a carpet bag, with improved clasp, by T. Laws; No. 309, trunk, by T. W. Mattson; Nos. 308 and 325, fly nets, by J. G. Mertz, and by August Miller; No. 310, spring trotting saddle, by W. Hawkins, Jr., and No. 363, light double harness, by M. Warne.

A number of articles belonging to this division were brought after 10 o'clock on Tuesday morning, and were consequently too late to come under the notice of the judges.

#### X.—*Models and Machinery.*

Although this department contained a great number of articles, many of which were ingenious, useful, and meritorious, the Committee have again to express their regret that this flourishing branch of the mechanic arts was not more fully represented. In order to enable moving machinery to be favorably exhibited, motive power was provided at considerable expense; but it was employed by comparatively few depositors. The display of working machinery adds greatly to the attractive interest of an exhibition, and would also, as it seems to the Committee, be much to the advantage of those who have new or interesting machines, with whose performance they desire to make the public acquainted.

In accordance with the report of the judges, the Committee make the following awards:

No. 1610, Boiler flues and gas pipes, by Morris, Tasker & Morris, Philadelphia. These articles are of admirable formation and excellent workmanship, and we think them worthy of the First Premium.

No. 1660, a power loom, by Alfred Jenks, Bridesburg, Pennsylvania. A neat and well finished machine, which the Committee regret

was not kept at work during the exhibition—nevertheless they award it the First Premium.

No. 1628, a portable grist mill and bolt, Fitzgerald's patent, deposited by Charles Ross & Co., New York. A valuable article for frontier and economical use, which is deemed worthy of the Second Premium.

No. 1658, tin work for factory purposes, by J. W. Butterworth, Philadelphia. Well made and substantial; deserving the Second Premium.

No. 1510, a cheese press, by James Edwards, Delaware county, Penn. Remarkably ingenious, pressing regularly and constantly by the weight of the cheese itself, and being of simple and economical construction. It merits the Third Premium.

No. 1511, a portable forge, by J. H. Gilbert, Peekskill, N. Y., deposited by Charles Jewell, Philadelphia. Ingenious and compact; but recommended to be made stronger in the working parts. Third Premium.

No. 1512, platform scales, by E. & T. Fairbanks, St. Johnsbury, Vt., deposited by D. P. Bussier, Philadelphia. Well made, neatly finished, and a trial shows as much delicacy as could be desired consistent with durability. We award the Third Premium.

No. 1657, scales, by J. D. Dale, Lansingburg, N. Y. Third Premium.

No. 1598, a mortising machine, by Wm. H. Howard & Son, Philadelphia. A well arranged instrument, to which the judges recommend the Third Premium.

No. 1611, a locomotive lantern, by N. Rogers, Utica, N. Y., an article of good appearance and construction, deserving the Third Premium.

No. 1596, iron fire proof safe, lined with soap-stone, by Evans & Watson. A very good article, of excellent materials and workmanship, worthy of the Second Premium.

No. 1553, blacksmiths' bellows, (40 inch) by R. H. Eckstein, remarkably well made, and deserving the Third Premium.

No. 1582, blacksmiths' bellows, with improved nozzle, by G. W. Metz. A very good article, to which we award the Third Premium.

No. 603, a corpse preserver, by John Good; an ingenious device for preserving dead bodies. The Third Premium.

No. 1501, a plough and cultivator, by Brown & Eyre, Newtown, Bucks county, Penn. These are substantial, well made and neatly finished implements. The plough has the appearance of ease to the draft and a good turn of the mould-board. We recommend its trial by the Agricultural Society, and award to the makers of these articles the Third Premium.

A lot of agricultural implements is also deposited by D. O. Prouty. These are of approved construction and good workmanship, worthy of the well-known establishment from which they come.

The judges notice the following as worthy of approbation: No. 1552, letter press and table, by Charles Evans; 1553 and 1570, blacksmiths' bellows, by M. S. Reeve, pickers for looms, by B. A. Holbrook,

Providence, R. I., deposited by Wm. Steel; 1582, specimens of ornamental castings, by Lloyd & Co.; 1594, a lateral shower bath, by P. B. Forsyth & Brothers, deposited by F. A. Fisher; 1613 and 1614, shower and vapor baths, deposited by J. Foster; 1635, wire work, by J. & D. Sellers; 1636, machine cards, by Sellers & Pennock; 1506, very well made bricks, of various patterns, by W. G. & C. Lybrand.

Many ingenious and well made articles were, as usual, deposited too late to be entered on the lists furnished to the judges. Among these we feel bound to notice a well constructed Cupola or Forge blower, of Dimpfel's patent, from the establishment of J. Kisterbock, on account of its own merit, as well as the good service it performed in stimulating the fire under the boiler of our steam engine in the lower saloon.

The following articles, being new inventions, are recommended to the Committee on Science and Arts of the Franklin Institute, for a more extended examination: No. 1534, diaphragm water filter, by W. H. Jennison; 1536, canal boat propeller, by Powers & Dunott; 1550, double forcing pump, by Wm. Romans; 1554, flexible truck for locomotives, by Norris; 1581, governor, by N. Scholfield; 1586, smut machine, by L. Tyson; 1575, wire heddles, by A. J. Williams; 1606, cotton cleaner, by B. Seguire; 1637, centrifugal pump, by Johnson & Lewis; 1645 and 1646, exercising swing and portable vapor bath, by Dr. Ross.

#### XI.—*Stoves and Grates.*

The spirited competition which exists among our enterprising stove manufacturers, generally secures a full display in this branch of the exhibition. New forms and ingenious devices for improvement appear at each succeeding season, and in the great variety deposited in our lower saloon, ample opportunity is afforded the public to choose according to taste, convenience or fancy. The judges appointed to examine this department express their satisfaction with the variety and general convenience of the articles brought under their notice, and, after diligent inspection, recommend the following awards:

No. 1526, Atwood's empire cook stove, made by Atwood, Cole & Crane, Troy, N. Y., deposited by E. Fizell, also by F. P. Wagner. Intended for burning coal, of neat form and satisfactory operation, meriting the First Premium.

No. 1652, air-tight cook stove, by P. P. Stewart, deposited by North & Harrison. This stove is calculated for coal or wood, though coal only was used in it during the exhibition. Its performance was satisfactory, and to it also is awarded the First Premium.

No. 1640, five stoves, of different kinds and patterns, by Jordan L. Mott, N. Y., deposited by Williams & Hinds. The ingenuity and perseverance of Mr. Mott in originating and introducing a variety of useful improvements and new principles of construction in stoves, have not only been creditable to himself, but have acted as an incentive to other stove makers to push forward in the race of competition. To his stoves the judges award the First Premium.

No. 1656, a portable cooking range, by Julius Fink, of Philadelphia.

phia. This is an article of neat form and convenient arrangement, deserving of the First Premium.

No. 1523, three cook stoves for coal, by Thomas Durell, Philadelphia. To these very excellent stoves is awarded the Second Premium.

No. 1555. Hedenberg's air-tight parlor stove, for coal, deposited by W. S. Hanford. The arrangement of the hot air passage, and general form of the stove, together with its economy, render it worthy of the Second Premium.

No. 1571, Roney's patent cook stove, deposited by Gray & Steel. This stove is of new construction, and designed to use both wood and coal on different hearths. The principle appears to be good, and the judges regret that the stove was not put in operation during the exhibition. They consider it deserving of the Third Premium.

No. 1530, Pierce's patent cook stove, made by Rikeman & Seymour, deposited by J. Kisterbock, is considered worthy of the Third Premium.

No. 1539, Wager & Dater's cook stove, deposited by J. Kisterbock, is also adjudged to merit the Third Premium.

No. 1654, a nursery stove, by Wm. Butcher: the Third Premium.

No. 1520, Pedder's patent reverberatory air-tight stove for coal, deposited by D. O. Prouty; an excellent and economical article. The Third Premium.

No. 1641, Utter's patent air-tight coal stove, made and deposited by Williams & Hinds. The draft of this stove is from the top, and so arranged that the gas does not escape into the room. Worthy of the Third Premium.

No. 1564, a sheet iron radiator, made and deposited by John McGrath. For the excellent workmanship and neat form we adjudge the Third Premium.

No. 1561, an agricultural furnace and boiler, by Jordan L. Mott, deposited by D. O. Prouty. A very useful article for farmers and others, and worthy of the Third Premium.

No. 1567, improved stove pipe holes and damper cups, by William S. Richards. Ingenious and useful articles, deserving of the Third Premium.

No. 1528, the Kisterbock cook stove, by J. Kisterbock; an excellent and useful stove, to which we award the Second Premium.

There are several other cook stoves, varying in form and arrangement, which the judges notice as creditable articles: among them are No. 1533, Church's cook; No. 1577, Bird & Well's air-tight cook; No. 1600, coal cook, by P. F. Hagar; No. 1629, Atwood's cook for wood, similar in construction and principle to the coal stove for which the First Premium has been given; No. 1655, cook stoves by Low & Bedell, Troy, N. Y., deposited by Lloyd and Feltwell; and No. 1540, by H. G. Bartels, deposited by J. M. Durand.

No. 1539, a revolving cook stove, invented by T. C. Clark, deposited by G. W. Holloway, is unfinished; but appears to be constructed upon useful principles.

No. 1541, a radiator, of new form and good workmanship, made and deposited by Kohler & Lenck, is noticed as a creditable article.

No. 1524, a furnace for warming houses, by J. B. Kremer, deposited by C. Clothier, seems to be constructed upon a good plan so far as the judges had the opportunity to examine it.

Several good stoves were deposited too late for competition, among which we notice one adopted by the Union Benevolent Society, sold at the very low price of \$3 00, and adapted to the use of the poor; some of Backus' patent, made by R. G. Kendall, also Harned & Elliot's air-tight stove, which received a premium on a former occasion.

## XII.—*Cabinet Ware.*

Many articles of furniture in this division are distinguished for taste in design, ingenuity of construction, and excellence of workmanship, reflecting great credit upon the makers. The judges appointed to examine this branch, notice as follows:

No. 1291, sofas, parlor chairs, arm chairs, ottomans, and centre table, by Vollmer & Montre, Philadelphia. This is a beautiful collection of furniture, which attracted much attention, both for its workmanship and good taste. The Committee deem it worthy of the First Premium.

No. 35, hair cloth, silk and hair, and satin de laine, by Samuel Ross, Philadelphia. Excellent specimens of taste and work, which may be confidently placed in comparison with the best European articles of the same fabrics. The satin de laine has a particular interest from the circumstance of its being the first manufactured in this country. It has a just claim to the First Premium.

No. 1215, rocking chairs, by Jos. F. Weaver, Philadelphia. These beautiful chairs present the novelty of having their frames composed of plated iron; thus combining strength, lightness, and simplicity of construction. For this improvement, and the skill with which the work is executed, the maker deserves the Second Premium.

No. 1202, couch and spring mattress, by Forst & Wright, Philadelphia. The spring mattress presents the convenience, and, as the Committee believe, the novelty of folding over upon itself when required. The arrangement for this purpose is simple and effectual. We award it the Second Premium.

No. 1242, French bedstead, by Quantin & Lutz, Philadelphia. This beautiful article is made of rose wood, and is richly yet tastefully ornamented. It merits the admiration which it excited, and although without much claim to originality or novelty, it is deemed worthy of the Second Premium.

No. 1265, red cedar bedstead, by Anthony Shermer, Philadelphia. This is a very elaborate piece of work, executed with much skill, though not free from fault in point of taste. The maker has shown that red cedar may take its rank among the most choice of the ornamental woods. For the present successful proof of this, the maker is awarded the Second Premium.

No. 1246, fancy, rush, and cane chairs, by A. McDonough, Philadelphia. These specimens of excellent work are deemed worthy of the Third Premium.

No. 1232, a fire screen, by Charles Goehmann. A truly beautiful

piece of work, showing particularly great skill in fancy turning. It deserves the Third Premium.

No. 1225, window shades, by Job F. Bray, Philadelphia. These articles have great merit, both in the preparation of the material, and in the designs and paintings. They show the great advance in this art since the last exhibition, and deserve the Third Premium.

No. 1259, venitian blinds, by B. J. Williams, Philadelphia. These are excellent specimens of work, and were generally and justly admired. We award them the Third Premium.

No. 1287, Venitian blinds, by J. B. Anderson, Philadelphia. For close shutting, these blinds were thought by the judges to have the advantage of others exhibited; but the difference was not so marked as to justify a formal decision on the point. They merit the Third Premium.

No. 1206, Venitian window blinds, by W. B. Barnes. This blind is intended to be sustained, at its different elevations, by a counter weight arranged for the purpose. As the counter weight, however, is constant, while the weight of the slats to be sustained increases as the blind is raised, it is evident there is but one point at which, independently of friction, there can be equilibrium between the blind and the counter weight. Accordingly, in its highest and lowest positions, the blind exhibited had to be kept in its place by other means. The device is probably new; but it is not likely to be generally adopted. Other good blinds were exhibited by the same maker.

No. 1272, centre tables and book case, by J. & A. Crout. In these articles the makers have distinguished themselves, as heretofore, by their beautiful combination of American wood, giving specimens of walnut, birch, and the tulip tree. These meritorious workmen have received premiums on former occasions for their skill and taste in this department of their business.

The judges also notice in terms of commendation, No. 1230, a set of parlor chairs, table and pedestal, by D. Schwartzwalder; No. 1269, a walnut flower stand by E. Nowland & Co., window shades, by F. Cerveaux, and by S. H. Warwick; and window screens, of wooden slats, by Martin Free.

### XIII.—*Musical Instruments.*

The judges selected to examine and report upon musical instruments, after careful examination of those deposited, remark that they are fully aware of the difficulty in making improvements in *Pianos*, and regret that among the great number exhibited (though equal to those in former exhibitions and creditable to the manufacturers) none are found presenting any superior qualities to those of late years. Nicety of mechanism in the keys, roundness, purity and evenness of tone, are the great desiderata in this instrument. A majority of the judges disapprove of the *Æolian* attachments to Piano Fortes, and likewise the introduction of harmonic pedals. They are strengthened in this opinion by the experience and practice of the great masters of Europe, who discountenance all these so called improvements, as detracting from the legitimate character of the instrument, and rendering its use too complicated.

The judges, after carefully, diligently and impartially examining all the pianos, and finding none superior to those formerly exhibited, declined making any awards; but the Committee determine the following to the three pianos most approved by the judges.

No. 1243, D. A piano by C. Meyer, Philadelphia, the First Premium.

No. 1240, B. A piano by Schomacker & Co., Philadelphia, the First Premium.

No. 1241, A. A piano by A. H. Gale & Co., N. Y., deposited by J. C. Smith; the Third Premium.

No. 1224 and 1250, three guitars, by C. F. Martin of Nazareth, Pa., deposited by C. H. Weber. The judges are of opinion that too much commendation cannot be bestowed upon these beautiful instruments. In strength and quality of tone they are unrivalled, and perfectly true throughout the whole scale. Being made with a degree of care hitherto unusual, they are found to bear the vicissitudes of our climate much better than the imported instruments. As this is now a permanently established branch of the arts, of a refined character in our State, the Committee desire to show their appreciation of merit, and aid in its encouragement, by the award of the First Premium.

No. 1255, three flutes, by J. Pfaff, Lancaster, Pa., deposited by C. R. Stellwagon. Instruments of superior workmanship and elegant finish. The tone of all is excellent, and they are true in the scales. The flute made entirely of cocoa wood is considered the best, and is deemed worthy of the First Premium.

No. 1270, a case of wind instruments, by Thos. J. Weygandt of Philadelphia. These display good workmanship, but do not show any advance in the art. The flute of cocoa wood, with ivory head piece, has a powerful tone, and is considered deserving of the Third Premium.

#### XIV.—*Glass, China, &c.*

The display of articles in this department is in a high degree creditable to the manufacturers, and shows the rapid advance of improvement in this interesting branch of our home industry.

No. 601, an invoice of glass ware, made by M. & T. Sweeny, Wheeling, Va., deposited by T. Sweeny. This ware is superior in richness of material to that from the same manufacturers at the last exhibition; and the judges believe it to be the best lot of flint glass ever made in this country. The beautiful vase, five feet one inch high, does great honor to the makers. Those only who are familiar with the manufacture of glass can appreciate the difficulties and hazards encountered in the execution of such a piece of work. The judges regard it as truly a triumph in American art, and from all the information they can obtain, it does not appear to have an equal for size and beauty in any country. It eminently merits the highest honor the committee can bestow—the First Premium.

In consequence, however, of the peculiar excellence of this article, the subject will be referred to the consideration of the Institute, for such higher award as may be judged proper.

No. 659, flint and colored glass, from the Dyottville Works, Kensington; deposited by S. D. Smith. The colored glass embraces a variety of shades, all of them good, but the preference is given to the canary. This tinge is beautifully imparted, and is richer than the best foreign that could be found to compare with it. The flint glass is very good. This lot of glass is worthy of the Second Premium.

No. 1546, earthenware, made and deposited by Abraham Miller, Philadelphia. This ware from Mr. Miller is better than any he has before exhibited, and it is particularly gratifying to observe the great improvement in the white ware. This alone merits the *First Premium*; but Mr. Miller being a member of the Board of Managers of the Institute, the regulations forbid any award.

No. 1548, earthenware, by Bennett & Bro., Pittsburg; deposited by Wright & Wharton. In this invoice there is a good variety of ware, and all very creditable. The jugs, mugs, and spittoons are decidedly better than the English Rockingham ware, which is used extensively in this country, and furnished at prices which must successfully compete with the foreign article. To the enterprising makers we award the Second Premium.

No. 632, large lights of glass, made by Coffin, Hay & Bowdle, Winslow, N. J. Lights of glass of American manufacture of this size are rare. The glass is not inferior in color to the best foreign; but is not so free from specks and waves as is desirable for the purpose for which such large lights are used.

No. 639, bottles and phials from the Dyottville Works, deposited by S. D. Smith. As good as any of the kind before exhibited.

No. 643, large cut glass bowl, and decanters, made by P. C. Dummer & Co. deposited by Lockwood & Smith. The bowl has been exhibited and reported upon at a former exhibition; the decanters are good, but not better than some formerly exhibited from the same factory.

### XV.—*Books and Stationary.*

The articles deposited in this line show little improvement over those of former exhibitions. It is suggested by the judges, that in future, the Binders should offer for premiums volumes in plain sheep, for medical and library use, and also volumes in muslin for Schools, and other works,—having reference to strength and fixedness of the volume in the case, as well as neatness of finish and gilding. Printers might also submit specimens of book work from machine and hand presses, so as to exhibit the improvements in types and the work of printing offices.

Great improvements have been, and continue to be made in the machinery connected with paper making, as well as the application of chemical principles to the art;—the result is a handsomer and better paper from inferior stock. It is suggested that competition be offered for printing paper, particularly a kind for every day sale at 12½ cts. per lb.

No. 143, a lot of books, by S. Moore, Philadelphia. The judges remark, that they cannot too fully commend the good taste and beautiful execution of the large bibles in silk velvet, with worked gilt

edges, clasps and bands. They also commend the neatness of work, and good taste in the arrangement of the Mosaic work on the volume of Lalla Rookh. To the binder is awarded the First Premium.

No. 612, gold pens, by Benedict & Barney, deposited by John C., Farr, are neatly made, elastic, and pass the ink freely. A more extended use than a mere first trial is, however, necessary in order to determine how far they surpass other metallic pens. This being a rather new branch of manufacture in our country, we consider these pens worthy of the Third Premium.

No. 1211, fancy printing by Howell Evans, is considered to merit the Third Premium.

No. 148, specimens of fancy printing, by W. F. Geddes, are very commendable, and might have obtained a premium had they been deposited in time.

No. 7, books by Cunningham & David, sustain the reputation of the binders, who received a medal last year.

The judges speak favorably of No. 121, a lot of Osborn's water colors; No. 117, books, by G. S. Appleton; No. 129, leads and motto wafers, by H. Cohen & Co.; and No. 634, a lot of ink, by A. W. Harrison, though they think an opinion should not be given of ink until it has withstood the test of time, and suggest that specimens of writing, done at least three months, should be deposited with each lot of ink, in order to show its quality of endurance.

#### XVI.—*Paper Hangings.*

But little competition appeared in this department.

No. 119, a lot of papers and borders, made by Howell & Brothers, deposited by J. & J. C. Finn, are considered by the Committee as deserving the Second Premium.

#### XVII.—*Fine Arts.*

The display in this branch of the exhibition is inferior, with a few exceptions to any offered for several years. This may probably be owing to the opening of the exhibition of the Artists' Fund Society and Academy of the Fine Arts at the same time. The following is in general accordance with the report of the judges appointed on this subject.

No. 1285, daguerreotypes by Simons & Collins. Some of these are equal to any specimens that we have seen in that branch of art, and are worthy of the First Premium.

No. 1218, daguerreotypes by W. & F. Langenheim. Very superior, and deserving the First Premium.

No. 1311, daguerreotypes by Van Loan & Mayall, superior and entitled to Third Premium.

No. 41, copper plates for engravers, by J. Juery. Very excellent specimens of workmanship, which the committee consider worthy of the Second Premium.

No. 1247, a bust of Washington, in marble, by F. H. Strecker. This is a work of fair merit, and entitles the maker to the Third Premium.

No. 1268, penmanship by W. Rushton. Very superior both in execution and design, and deserving the Third Premium.

No. 1284, stucco ornaments, by W. S. French, are considered good work for a pupil, and worthy of the Third Premium.

The judges also speak favorably of No. 1209, crayon drawings by a pupil of the High school. No. 1279, pencil drawings by G. F. Solomon; and No. 1214, engraving and crayon drawing by A. S. Wagner.

No. 1322 and 1327, very beautiful and accurate crayon drawings by Ph. Beaugureau, and by his son, a very young pupil, were deposited too late for competition, as were several other specimens in this department.

#### XVIII.—*Silver Ware and Jewelry.*

The number of articles deposited in this department, is comparatively small, and the committee have to express their regret that the manufacturers in this interesting and attractive branch have generally neglected to avail themselves of the opportunity thus afforded them to show their work and enter into competition for the honors of the Institute.

No. 655, a plain silver tea set and octagon pitcher, in the lot of silver ware made and deposited by R. & W. Wilson, are considered as entitled to the First Premium.

The Messrs. Wilson generally contribute largely to our exhibitions, and the work offered by them this year, in point of taste and workmanship, fully sustains their reputation for excellence.

#### XIX.—*Bookbinders Work and Tools.*

The assortment of articles deposited under this head is very limited, but of considerable merit. The judges selected to examine this division recommend the following awards.

No. 101, marbled paper, by Galbraith & Frost, Philadelphia, an article of the highest merit, which by its superior execution and finish has established its reputation in this country to the exclusion of that of foreign production. Being made at a price 40 or 50 per cent. cheaper than the imported, it has completely superseded all other. It is considered worthy of the First Premium.

No. 126, specimens of chasing for embossing, by an apprentice, Eugene Wagner,—meriting commendation and encouragement. We therefore award to him the Second Premium.

#### XX.—*Marble Work.*

Notwithstanding the large amount of excellent marble work done in this city and its vicinity, our collection is small. The judges of this branch report as follows:

No. 1509, marble mantel and polished slabs, by John Eckstein & Co. The mantel is of statuary marble, and is of good design and workmanship. The vine encircling the frieze and pilasters is well executed and the whole is creditable to the workmen. It is entitled to the Second Premium.

The slabs are of domestic and foreign marble, highly polished by patent machinery.

### XXI.—*Hats and Caps.*

This branch of domestic industry is generally well represented in our exhibitions, and this year, owing to the emulation existing among our enterprising hatters, the display is superior to any shown on former occasions. The improvement in manufacture is such that competition from abroad is scarcely thought of. English hats, formerly plentiful, are now seldom seen, and the Paris silk hats are only worn because they come from Paris, and not from any superiority they possess over those made in this country.

The judges appointed to examine this department say that there are hats in the present exhibition so perfect that they are at a loss to conceive in what particular they are susceptible of improvement, combining as they do, all the excellencies of quality, color, finish, and trimming.

No. 952, nutria hats and chapeau, by Orlando Fish, N. Y. These are splendid specimens of manufacture. The military hat is much admired for the taste and neatness of its shape and trimmings—the First Premium.

For silk hats, by the same maker, the Second Premium.

No. 975, hats, by Sullender & Pascal, Philad. These makers have advanced their claim to public favor since the last exhibition, and from the taste displayed in the specimens exhibited, the judges think them entitled to consideration. To their beaver hats is awarded the First Premium.

No. 996, hats of different kinds, by Bertrand Ross, Philad. All splendid specimens of the art. The judges think that the silk hat in this collection exceeds all others for the beauty of its finish, its lightness, its freedom from imperfections on the closest scrutiny, and in fact all the combinations necessary to form a perfect hat. It is entitled to the First Premium.

No. 998, silk hats and velvet caps, by John Hile, Philad. These are very excellent specimens of silk hats, free from that stiffness or hardness formerly accompanying this kind of goods, and possessing the softness and pliability of a fine beaver hat. The caps are very beautiful. For the hats we award the Second Premium.

No. 1022, hats, by Andrew McCalla, Philad. Handsome specimens; well made, finished and trimmed. The nutria hat in this case is deemed worthy of the Second Premium.

No. 1042, hats, by Emmor Kimber, Jr., Philad. which do him credit for their workmanship. The "Friend's hat" is considered as deserving of the Second Premium.

No. 1041, hats and fancy caps, by James Hunt, Philad. Excellent specimens of manufacture, and entitled to the Third Premium.

No. 1043, hats and caps, by Bartalot & Blinn, Philad. The key of this case was not furnished to the judges, and they were of course precluded from making a proper examination. From what they saw,

however, they infer that a closer inspection might have entitled these goods to at least the Third Premium.

No. 1016, muffs, mantillas, boas, &c., a lot of fur goods, from Geo. F. Womrath, Philad., of beautiful workmanship; worthy of the Third Premium.

The judges speak favorably of No. 945, hats by Post & Miller; No. 983, by Samuel Hudson; No. 987, wool hats by J. Miller; No. 990, hats, by Edward Hunter; No. 991, a Friends' hat, by B. H. Lightfoot, and No. 1036, hats by O. Brooks. The key of case No. 1023, hats, by Britton & Clery, was not left with the judges, but from outward observation they appear creditable. No. 1034, fur goods by Solis & Brother, appear to be well made.

A number of hats were deposited after the time prescribed by the rules, and consequently were not entered on the list furnished to the judges. Of these, the hats of Oakford, Walton, and Bulkley, are respectively creditable to them as manufacturers of long standing, and in keeping with their well earned reputation.

Mr. John Simpson has added much to the interest of the Exhibition by enabling visitors to witness, in the lower saloon, the ingenious process of making hats. For this, and his general attention, he merits the thanks of the Institute, and in the opinion of the judges and the Committee, he deserves for the chapeau and the hats actually fabricated in the Exhibition rooms, the First Premium.

#### XXII.—*Combs and Brushes.*

The assortment deposited is not large, and the judges express their regret that there seems to be so little disposition to enter into competition in this line. Some of the paint and other brushes are very well made; but nothing being exhibited which shows improvement over former displays, no awards have been made.

#### XXIII.—*Coach Work.*

In accordance with the report of the judges selected to examine this department, the Committee make the following awards.

No. 1537 and 1543, a rockaway wagon, and Spanish volante, by William Dunlap, of Philad. Excellent articles in workmanship, symmetry, and taste. Deserving of the First Premium.

No. 1565, dray wheels and axle, by Wm. Snyder, Philad. strongly made, and most excellent workmanship. Worthy of the Second Premium.

The judges notice as creditable specimens, No. 1545, a child's carriage, by Wm. Kennedy; No. 1585, a velocipede, &c., by H. H. Brown; No. 1615, model of a carriage brake, by Richard J. Lamborn; No. 1620, willow carriages for youth, by P. Simpson, deposited by E. H. Jones; No. 1625, velocipede, by B. M. Edenborn; No. 1662, a model carriage, by Richard Stanwood, Frankford, Pa.

No. 1677, a very neat and well finished sleigh, by Geo. W. Wagner, of Roxborough, Philad. County, was deposited too late to come within the rule for entering on the judges' lists.

**XXIV.—*Leather and Morocco.***

In variety and quantity, this important branch of our home manufactures was fairly represented. Careful and skilful judges were selected, who, after diligent examination, recommend the following awards.

No. 340, sole leather, by W. H. Crawford, the Second Premium.

No. 341, sole leather, by C. R. Williams, the Second Premium.

The judges remark that they perceive little or no difference in the quality of these two lots of leather; both being of the best kind, well filled with the tannin principle, and remarkable for solidity and firmness, particularly in the shoulders and offal parts of the hide, which is the great characteristic in good sole leather.

No. 370, calf skins, by Henry M. Crawford. Very superior both in material and workmanship; combining great softness and pliability with fineness of texture, firmness and solidity. Worthy of the Second Premium.

No. 397, split leather, by Samuel Hall; a very superior article, fine and pliable. Deserving of the Second Premium.

No. 394, enamelled chaise hide, by John Chadwick, Newark, N. J., deposited by H. & G. Fricke. Although not so large as other specimens, yet the workmanship and finish show great care and skill. It is considered as entitled to the Third Premium.

No. 364, rub kid morocco, by G. & H. Moore. A superior article for solidity and firmness, pliability, softness and polish. To which is awarded the Third Premium.

The other specimens exhibited are considered as creditable; but not entitled to a particular award.

A lot of Japanned leather, No. 426, by the Boston Manufac. Co., deposited by S. W. Patten, came too late for entry on the judges' list. It is a fine and sound article.

**XXV.—*Boots and Shoes.***

This department of the Exhibition is creditable to the depositors on account of the quality and style of the goods, though a greater variety of ladies' shoes would have been desirable.

The judges appointed to examine this branch remark, that, although they admit and admire the adaptation of skill in this department of the mechanic arts to suit the varying mode of fashion, yet they discover the development of no new principle, by the advancement of which former competitors are eclipsed, or superior advantage derived to the public.

No. 362, ladies' gaiter boots, by H. F. & W. Rodney. Fine articles of good quality and style; creditable to the makers as samples of manufacture. Entitled to the Third Premium.

No. 359, ladies' shoes and gaiter boots, by C. Fontaine. Fine dress articles, rather than for common wear and general utility. As such, they are considered to be the best exhibited, and merit the Third Premium.

No. 312, gentlemen's fancy and fine dress boots and gaiters, by S.

Rothschild. These are fine samples, executed in a workmanlike manner. Deserving the Third Premium.

No. 334, U. S. Army bootees, by Pitman & Fimple. Superior articles of their kind; made of good leather; the workmanship exceedingly plain and strong, without any display of show at the expense of durability. The makers deserve the Third Premium.

No. 391, boots by L. Benkert, and No. 395, boots by C. Benkert, are highly commended by the judges, and are considered fully equal to those for which they both received Premiums last year.

No. 402, ladies' shoes and boots, by J. R. Douglas, and No. 348, gent's boots and slippers, by Henry Herth, are favorably noticed as very creditable specimens of work.

## XXVI.—*Chemicals.*

In this interesting department the display was excellent, and the articles generally such as to reflect credit upon our operative chemists as manufacturers, although no very marked improvement is noticed over those in the last exhibition. The chemists who were selected as judges of this division, recommend the following awards.

No. 317, calcined magnesia, by Thos. J. Husband, Philadelphia. This article, though not yet equal to Henry's, is far superior to the ordinary preparation, and to much that is sold under Henry's name. The judges deem the preparation highly creditable to Mr. Husband, and in the hope that he will make further exertions to perfect it, they award him the Second Premium.

No. 1633, black lead crucibles, by T. J. Dyre, Jr. & Co., Philad. An assortment of various sizes and excellent quality; deserving the Second Premium.

No. 349, hyposulphite of soda, by Dillwyn Parrish, Philad. The handsomest chemical preparation in the exhibition; for which, on account of its perfect crystallization, and its important uses, we award the Third Premium.

With regard to other chemicals exhibited, the following remarks are extracted from the report of the judges.

Of chemicals manufactured on a large scale for the market there is but one laboratory represented; that of Farr, Powers & Weightman, the excellence of whose preparations has frequently received the deserved tribute of admiration from the Institute. The lot exhibited this year maintains their character, but as there is no perceptible improvement over those for which they last year received a medal, the judges do not recommend a second award. Among the articles of especial beauty in this lot are, nitrate of silver, muriate of tin, tannin, brucia, strychnia, morphia, and their salts.

Smith & Hodgson, William Procter, Charles Ellis & Co., and Jenks & Ogden, display chemical preparations which are very creditable to their skill and science. Among those best entitled to notice are the chromic acid of Smith & Hodgson; various colored crystallizations by Procter; the oils of cubebs and copaiba by Ellis; and the citrate of potassa from Jenks & Ogden. The judges are not, however, aware of any special merit which attaches to these or of any practical diffi-

culty in the preparation. No. 315, iodide of lead, by Peter T. Wright, is a very beautiful preparation; but a mere hand specimen, not of sufficient importance to merit any specific award. No. 316, is a very good looking citrate of iron, by Jacob L. Smith.

No. 319, a mould of crystallized acetate of lead, by Mord. Lewis; and No. 406½, a similar mould of the same from Harrison & Brothers. Both these articles are very beautiful, well crystallized, and highly creditable to the manufacturers. A large mass of alum from the works of Harrison & Brothers, is a beautiful specimen, and aided, in no small degree, in attracting attention to the chemical table.

No. 367, a bottle of lard oil, by W. S. Brown & Co., is well prepared, of light color and excellent quality; but whether it is an article intended for the market, or only made upon a small scale, we have no information. The same remarks apply to No. 371, a jar of sulphate of quinine. No. 303, extract of indigo, by A. Gunn, deserves attention for its beauty and depth of color; but can be better judged of by practical dyers. No. 390, a lot of mustard by C. J. Fell & Bro., appears to be an excellent article, and worthy of recommendation for domestic use.

Specimens of starch, No. 322, by W. Altemus; No. 347, by S. T. & G. Stratton, and No. 381, by Kessler & Walmsley; all seem to be well prepared; but none of them as free from acid as is desirable. The judges are not prepared to assign the superiority to either of them over the others.

### *Soaps and Perfumery.*

The great display of these articles excited much attention, and added in no small degree to the interest and general effect of the exhibition.

No. 387, a lot of soap, by J. R. Graves. This enterprising and skilful manufacturer received a silver medal for common soaps last year, and those now exhibited are fully equal to his former display, or to any exhibited.

No. 406, soap, stearic, spermaceti and tallow candles, and cakes of purified spermaceti. by Coffin & Landell. The soaps exhibit great excellence in the manufacture; the stearic candles are also very good, the spermaceti is beautiful and highly creditable to the manufacturers, to whom is awarded the First Premium.

No. 333, soaps and stearic candles, by Miller & Brown. The judges apply the same remarks to these soaps and candles, as to those of Coffin & Landell, and no preference being expressed, we make the same award of the First Premium.

No. 314, transparent, fancy and floating soaps, by H. P. & W. C. Taylor. We have before had occasion to notice the excellence of the articles produced by these young and enterprising manufacturers, and consider them entitled to the Second Premium.

All the displays of perfumery are creditable, and the Committee are glad to perceive the absence of foreign labels, which were so conspicuous at the last exhibition.

No. 382, lot of perfumery, soaps, &c., by E. Roussel. The judges

consider that the preference belongs decidedly to this establishment. To it, therefore, is awarded—for perfumery, the First Premium. For fancy soaps, the Third Premium.

No. 408, a lot of perfumery, soap, &c., by Jules Hanel. This is very good; but little improved since last year. For perfumery, the Second Premium. For fancy soaps, the Third Premium.

No. 405, perfumery, soap, &c., by A. E. Wetherill. This manufacturer deserves notice and encouragement. His articles are very good. For perfumery the Second Premium. For fancy soaps, the Third Premium.

No. 379, a beautiful display of Cologne water, by N. B. Hinton, the excellence of which has been noticed in former reports. To this we award the Third Premium.

No. 387, fancy soaps, by J. R. Graves, are considered as deserving of the Third Premium.

Roussel exhibits mineral water, in the manufacture of which he has not fallen off. He received a Premium for it at the last exhibition.

#### XXVII.—*Philosophical Apparatus.*

The number of instruments constructed for scientific purposes, and deposited in this department of the Exhibition, was large; and it is truly gratifying to be enabled to remark that they were generally of a character to reflect great credit on the makers.

No. 619, a case of machine and drawing instruments, by Wm. M. Snyder. The judges appointed to examine this department say that they are instruments of admirable design, and evince the highest degree of accuracy in the construction. They are deemed worthy of the First Premium.

No. 708, platina crucibles, blowpipe, spoons, &c., by Joaquim Bishop. These are much superior in firmness and durability to those imported from Paris; but in smoothness and finish still leave something to be desired. They merit the First Premium.

No. 1293, scales, weights and measures, by F. Meyer & Co. The set of standard weights and measures made for the County of Philad., in pursuance of a recent act of the Legislature, are very close copies of the beautiful originals furnished by the U. S. Government. The execution and workmanship are in a high degree creditable to Mr. Meyer, and we award him the First Premium.

No. 708, a double 36 inch plate electrical machine, by Joaquim Bishop. The substitution of wood, in place of the metal usually employed for the axis and collars, is commended by the judges as avoiding the loss of electricity consequent upon the common arrangement. The whole machine is well constructed and creditable to the maker. It deserves the Second Premium.

No. 691, a magneto-electrical machine, by J. Duffey, Sr. This machine is arranged after the original plan of Mr. Saxton; is well constructed throughout, and in common with other articles by the same maker is highly creditable. To him is awarded the Third Premium.

No. 703, electro magnetic apparatus, by James Bingham. One of

these instruments deposited by this maker is commended by the judges as very simple in arrangement, compact and durable. It avoids the use of a secondary magnet as a contact breaker, and by simply moving the spring, alters to any extent the points of contact. It is worthy of the Third Premium.

The judges also notice favorably No. 1623, rain gauges, by I. Lukens; No. 640, galvanic plating, by W. B. Jenner; and No. 644, spirit levels, by N. Shaw.

They also commend No. 1239, a clock, by the Forrestville Manufacturing Company, deposited by A. E. Lovell. An ingenious arrangement, acting by a spring, chain and lever, without weights; very convenient of transportation, and calculated to save much trouble to persons not acquainted with setting clocks in motion.

#### XXVIII.—*Straw Goods.*

But few articles in this line have been deposited. The judges consider those in the present exhibition as fair and creditable samples; but perceive nothing superior to those of the same class shown on former occasions.

#### XXIX.—*Surgical Instruments.*

The articles deposited under this class have been carefully examined by competent judges, with the following results:

No. 697, artificial teeth, by Dr. E. A. Wildman. These are of good workmanship, accurately and delicately colored; and equal to those for which the maker received a medal last year.

No. 657, artificial teeth, by Edward Townsend. For these the judges recommend the Second Premium.

No. 642, specimen of dentistry, made by Dr. R. T. Reynolds, deposited by C. C. Burr. The judges regret that but one specimen was deposited, but award to the maker, for superiority of workmanship, the Third Premium.

No. 1298, a bed for the sick, by George Ritter. This is a new and ingenious contrivance, well calculated for the comfort of patients who, from great debility, or other causes, are rendered unable to be moved from a fixed position. It is considered worthy of the Third Premium.

No. 739, a dental articulator, by J. W. Chapman, is highly spoken of by those qualified to judge of its merit; but as it was not deposited within the time prescribed by our rule, no premium is awarded.

The judges make favorable mention of No. 641, sets of artificial teeth, by A. R. Johnson; No. 615, syringes, by Calverly & Co.; No. 702, laced stockings for surgical pressure, by Wm. Mitchell; and No. 607, an "Anti-Dyspeptic chair," by Oliver Halstead, N. Y.

#### XXX.—*India Rubber Goods.*

The exhibition of India Rubber or Gum Elastic goods is inferior in several respects, to the display of articles of this kind on previous occasions.

No. 388, over shoes and boots, made and deposited by John L. Ripley. Some of these are made with gum alone, and others with leather

soles and gum shanks; all of neat appearance and good workmanship, for which the judges recommend the Second Premium.

They also enumerate, as deserving of special mention, the following: No. 330, overshoes, from the Goodyear India Rubber Company, Naugatuck, Conn., deposited by Holmes & Hubbard; No. 376, India rubber belting and other articles, from the Naugatuck Company, deposited by Carr & Haines; and No. 377, machine belting, by Henry Edwards, Roxbury, Mass., also deposited by Carr & Haines.

The Committee regret that several deposits of India Rubber goods were made after the time prescribed by our regulations, and which consequently were not entered on the lists furnished to the judges.

### XXXI.—*Copper, Brass, and Plumbers' Work.*

The following awards and notices are in accordance with the report of the judges who examined the articles deposited under this head.

No. 158<sup>2</sup>, hemp hose, by Amasa Stone, Philadelphia. Well made, strong, and decidedly the best hemp hose which has come under our notice; worthy of the Third Premium.

No. 1638, iron hydrants, by C. H. Canby & Son. Well constructed, and certainly an important improvement on the old wooden hydrants. It is stated that they can be repaired without digging up; but the mode of doing this was not explained. They deserve the Third Premium.

No. 1538, two stop cocks, by R. Stileman. These are well made, and of a pattern far superior to those used by the City Water Works; they are highly creditable to the maker, and merit the Third Premium.

No. 1597, lead pipe, lined with tin, by Lowber & Leroy, N.Y.; deposited by Gabell & Hughes. This pipe is well made, the tin adhering closely to the inner surface of the pipe. It is doubted, however, whether the lining of leaden pipe with tin is an art of any importance. It was effected in New York in consequence of an absurd notion that water was poisoned by passing through lead pipe. If this be so, it must be a *very slow* poison, as we have been using the lead pipe in Philadelphia for the last 40 years.

Nos. 1609 and 1626, leather hose, of different sizes, by — Dialogue, Philadelphia. The work of this maker has often been noticed favorably by the Institute, and the present specimens are fully equal to any formerly deposited.

No. 1616, two bells, by L. Debozeur, Philadelphia, and No. 1639, two ditto, by J. Bernhard, Philadelphia. Between these competitors there is little difference in the appearance of the castings—the smaller bells being fair castings, and about the same quality. The large bell, by Debozeur, weighing 3018 lbs. is not so smooth. No opportunity was given to judge of the tone.

No. 1678, lead pipe, by Tatham & Brothers, was deposited too late for competition. It is a beautiful article, fully sustaining the high reputation of the manufacturers.

### XXXII.—*Tin Work.*

Though the deposits in this line were not extensive, yet they con-

tained many beautiful and highly finished articles; and the judges remark that they are much gratified to discover a decided improvement in the manufacture. It is a matter of regret to the Committee, that among our numerous and skilful tin plate workers, so few seem inclined to enter into competition in this branch.

No. 1556, a lot of tin ware, by Isaac S. Williams. This is a large assortment, comprising a great variety of beautiful and useful articles, of excellent material and workmanship. It is considered worthy of the First Premium.

No. 1578, tin work, by Cannon & Brother. Very well made, and deserving of the Third Premium.

No. 1643, a machine for double seaming copper and tin, by Daniel Newton, Louisville, Kentucky. A very suitable tool for that purpose, and which merits the Third Premium.

The Committee also award to Daniel D. Dick, for excellent specimens of japaning and gilding on tin ware, the Third Premium.

### XXXIII.—*Paints and Colors.*

The articles deposited under this head were examined and tested by the judges appointed for that purpose, who characterize them generally as good and fair specimens.

No. 327, red lead, manufactured by George Uhler, Philadelphia. A very superior article, and worthy of the Third Premium.

No. 307, water black, by Thomas Matlack, Philadelphia, is an article much wanted in this country, to take the place of the English drop black, for mixing in water. The maker is entitled to the Third Premium.

Lamp black, by the same maker, sustains its former reputation, being a fine pure article. White lead, by Mord. Lewis, Geo. Uhler, and E. Davis & Co. are all good specimens,—as also are the orange mineral and litharge by George Uhler and E. Davis & Co.

### XXXIV.—*Fancy Articles.*

This department, is, as usual, very large, comprising a vast variety of articles of very different grades of merit, from the most beautiful specimens of taste, skill, and ingenuity, down to very ordinary and trifling specimens. It contains, indeed, a number of articles which should not have been admitted to the exhibition, inasmuch as they reflect no particular credit upon the general display, or upon their makers. The judges, after careful examination, recommend the following awards.

No. 903, a case of artificial flowers, by James D. Brown. Made in excellent taste, of good materials, and equal in appearance to French. Worthy of the Second Premium.

No. 1013, pearl work, by R. & A. Walter. Very well made, and equal in appearance to the imported. It merits the Third Premium.

No. 1026, a shell basket, by Miss Anna Campbell, of exquisite taste and workmanship; the Third Premium.

No. 1038, two plates of wax fruit, by B. G. Boswell; exceedingly well done, and deserving the Third Premium.

No. 1007, two cases of wax fruit and vegetables, by Catharine A. Smith. Beautiful specimens, particularly the vegetables; they merit the Third Premium.

No. 919, fancy feathers, by Mrs. Amanda Freeman. These are very beautiful, and display great skill in the workmanship; the Second Premium.

The following articles are also mentioned by the judges as worthy of favorable notice. No. 936, fancy hair and shell work, by Mrs. Henry; No. 1044, a vase of wax flowers, by Mrs. Hamilton; 930, epaulettes and head dress, by T. R. Korn; 951, hair pins, necklaces, &c., by R. S. Killingsworth.

No. 1025, a case of wigs and toupees, by Bogue & Fawcett, are specimens of very superior workmanship in this line, and are deemed worthy of the Second Premium.

A number of excellent and elegant articles of fancy goods were deposited too late for entry on the judges' lists, among which we particularly notice No. 1054, very elegant fancy tabs, cap ornaments, &c., by Madame Juel.

No. 1012, an herbarium of well selected and beautifully preserved plants by J. Cooley, was examined by a committee having knowledge of the subject, and at their recommendation we award the Third Premium.

### XXXV.—*Household Articles.*

In this department, comprising a vast variety of articles of domestic utility, the display was respectable, and creditable to the depositors. In conformity with the report of the judges who examined this division, the following awards are made.

No. 1535, a lot of neatly made willow ware, by Robert Swift; the Third Premium.

No. 1612, brooms, by Geo. Chipman. Very well made; the Third Premium.

No. 1262, cedar ware, by W. Boyer. Some of this ware is beautifully made, and highly creditable; the Third Premium.

No. 1551, a barrel of flour, of very superior quality, manufactured by H. G. Brady, Greensburg, Pennsylvania, and deposited by E. G. Dutilh & Co.; the Third Premium.

The judges also notice with approbation the following: No. 1537, the cedar ware, by S. Tompkins; No. 1574, buckets, knife trays, butter prints, cutters, &c., &c., by various makers, deposited by J. J. Evans; and No. 1620, willow ware, by Philip Simpson, deposited by E. Hicks Jones.

Bread is deposited by J. G. Moxey, Ridge Road, which is truly excellent, and sustains his well-earned reputation as a baker. Bread, made by a lady, is also deposited, which the judges decide to be highly creditable to the maker.

Refrigerators and water filters are deposited by Evans & Watson, and also by Oliver Evans. These gentlemen have received premiums for their excellent articles at former exhibitions; and those now presented are worthy of the well-known manufacturers, who still continue eminent in this line of business.

XXXVI.—*Clothing and Needlework.*

In this division of the exhibition, the judges feeling that they needed the aid of feminine taste and judgment, are happy to acknowledge the efficient service of a committee of ladies, who very diligently and carefully examined the large assortment of articles in this department. A very sensible and well written report was received from that committee, and the judges, relying on the superior knowledge possessed by these ladies with regard to most of the articles enumerated, have been guided, in a great measure, by their report.

No. 1005, two raw silk bonnets, made and deposited by Mrs. C. A. Huddleston. A new article, of beautiful style, and worthy of the First Premium.

No. 1082, a specimen of thread lace, made by Hannah Wheeler, of Salem, N. J. An exceedingly good article, believed to be the finest ever made in this country. Although this specimen came too late for competition, yet the committee on exhibitions, from the circumstance of its being a beautiful sample of a new manufacture in this country, have determined to make it an *honorary award* of the First Premium.

No. 32, a bedspread, knit by Elizabeth Solomon, a pupil in the Pennsylvania Institution for the blind. As a specimen of work by a blind girl, this article is worthy of the Second Premium.

No. 941, a case of calf skin and kid gloves, by G. R. Corry; very beautiful and well made goods, to which we award the Second Premium.

No. 976, two cases of shirts, by John Hodges, of good workmanship and improved pattern, Third Premium.

No. 923, a woven bed quilt, by Mr. Gallagher, West Chester, Pa., deposited by Spencer Roberts; Third Premium.

No. 11, buckram foundations, made and deposited by Ter Hoeven, Frankford, Pa. Very superior, and worthy of the Third Premium.

No. 1291, needle work ottoman, by Mrs. Robarts; a beautiful specimen, deserving the Third Premium.

No. 974, frame needle work, by Miss Eliza Sauerbier. A remarkable specimen, executed by a child 10 years old; Third Premium.

No. 32, case of needlework and fancy goods, made by the pupils of the Pennsylvania Institution for the blind; remarkable for beauty and neatness, as well as being the production of persons deprived of sight; worthy of the Third Premium.

Nos. 953 and 954, satin stocks, dressing gowns, &c., by C. A. Walborn. These are very superior goods in style and finish, maintaining the reputation of the establishment from which they come. Mr. Walborn being a manager of the Institute, our rules forbid an award.

No. 145, a case of gloves, by J. R. Ashford. Very well made, and considered fully equal to those for which he received a premium last year.

The following articles are considered as entitled to favorable notice and commendation. No. 993, shirts, by E. Durham; 935, a white bed quilt, by Elizabeth Jones; 926, bonnet and hat, thread knit, by

Mrs. Lenthall; 1048, plaiting, by Mad. Juery, done by hand and very superior; 916, ottoman covers, by Mrs. Sybil Smith; 1040, frame needle work, by Mary Franks; and 906, embroidery on satin, by Jane R. Wray.

Some very creditable specimens of tailors' work are exhibited, among which are noticed, No. 949, a black dress coat, by F. Mahan; 1002, sack coat, by Bennett & Co.; No. 1030, a bangup, by John Reynolds; and No. 961, boy's clothing, by F. A. Hoyt; No. 1087, a highly finished and well made sack coat, by Leidy & Peters, was deposited too late for competition, as were also several other good articles.

### Conclusion.

And now, in closing their arduous duties for the present year, the Committee would remark, that having conferred on articles, which they deemed the most deserving, the number of *fifty-one* First Premiums,—on those of the next grade *fifty-two* Second Premiums,—and those of a lesser degree of merit, *one hundred and thirteen* Third Premiums; and having also noticed as worthy of credit and approbation such other articles as they conceived worthy of such mention; they return their thanks to the depositors and to the public, for the interest manifested in the exhibition. It has been computed that including members of the Institute, depositors, and ladies and minors introduced by them, not less than *seventy thousand* persons visited the rooms during the eleven days they continued open. This degree of attention and public favor is honorable to the Institute, and will be felt and regarded as a renewed stimulus to exertion in accomplishing the great object of its charter, “the promotion of the mechanic arts.”

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## COMMITTEE ON SCIENCE AND THE ARTS.

### *Report on Jos. S. LOVERING & Co.'s Double Refined Sugars.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination specimens of Double Refined Sugars, manufactured in the city of Philadelphia, by Messrs. Jos. S. LOVERING & Co.: REPORT,

That they have completed an elaborate investigation respecting the purity of the above named sugar, and its economical value, compared with other refined sugars.

The specimen of sugars which was placed in the hands of the committee, was a well formed loaf, weighing about 15 lbs., which was taken, indiscriminately, from amongst a large number of others, and deemed by the committee to be a fair average specimen of the article as prepared for market; although, perhaps, somewhat inferior to that which was deposited at the last exhibition of the Institute.

The committee do not consider it necessary to detail the numerous experiments which were tried by ultimate analysis, by fermentation, by incineration, by the polarization of light, and by the copper test; and which, in their estimation, conclusively demonstrate the superiority of the above sugars. It is found to approach much nearer to chem-

ical purity than was to be anticipated from considering the large scale upon which it is manufactured. In reflecting upon this, in connexion with the extreme proneness to alteration, from the action of slight disturbing causes, which sugar exhibits, and the many delicate processes through which it has to pass before it is brought to such a degree of purity, the committee have felt that they could not withhold the expression of their admiration.

The committee, moreover, highly appreciate the enterprize and skill which the Messrs. Lovering & Co. were the first, in this country, to exhibit, in applying some of the refined improvements in modern science to a most important and extensive branch of the manufacturing arts.

In conclusion, the committee state that, in their opinion, the Messrs. Lovering & Co. are deserving of the highest award of the Institute, on account of the perfection to which they have brought the refining of sugar, and the great superiority of their *double loaf sugar*.

By order of the Committee,

WM. HAMILTON, Actuary.

*Philadelphia, June 12, 1845.*

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*Report on HUBBELL'S Improvement in Fire Arms.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the improvement in Fire Arms, by WM. W. HUBBELL, Esq., of Philadelphia, Pa. :  
REPORT,

That they have examined the same, and find it to consist, in the language of the claim in the patent, of a "breech opening and closing on a rod as a centre, &c.," or, in other words, of a movable breech, which turns upon a joint formed of a screw bolt, which connects the barrel with the stock; a correspondent screw bolt, parallel with that last mentioned, upon the opposite side of the breech and barrel, also serves to connect the barrel with the stock, and aids in support of the recoil; there is, in addition, a connecting bar under the barrel, which aids in tying it to the stock. The whole forming a cradle, in which the breech lies when in its place for firing, and in which it is held by a spring conveniently placed for that purpose.

The committee are of opinion that the construction admits of rapid charging and firing, with cartridges, or otherwise, with ball and buck-shot, or small shot, at will. That the movable breech may be safely constructed, that the fastenings or ties by which the barrel and stock are connected are well placed, and that the whole arrangement is not more bulky than seems essential in the construction of fire arms with a movable chamber.

It is proper to add, nevertheless, that the examination of the committee was confined, necessarily, to a visual inspection. This arrangement, like every thing else, is liable to inconveniences in use; the committee, as in duty bound; will point out those likely to affect that under consideration, the most prominent of which is the want of sufficient

strength in the parts which attach the breech to the barrel; a slight accident might bend or otherwise derange the screw bolts which connect the stock to the barrel, which, if it did not render the piece useless, would throw the breech and barrel out of line, a very grave objection on all accounts.

It is also evident that the junction of the barrel and breech, these parts being merely in contact by the bending down of the breech, must leave some space for the escape of vapor during the discharge, which will increase by wear, during use. It is probable that the ingredients of the powder may produce irregular corrosive action on the surfaces of junction, which could not be compensated by the screw bolts, from which a loss of propulsive power would result.

There is some doubt as to the strength of the ties between the barrel and stock; an accident from failure in this respect would be disastrous. The utmost caution, therefore should be exercised to guard against the possibility of its occurrence.

These views are necessarily speculative, and must be received as the opinions of the committee, after examination and reflection, for whatever they are worth. A faithful trial, by oft repeated discharges under ordinary circumstances, such as could be given by the ordnance department of the General Government, would either establish its merits, or consign it to its just fate.

The committee have expressed no opinion as to the originality of the above improvement; not having investigated that point.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

*Philadelphia, Sept. 11, 1845.*

## MECHANICS, PHYSICS, AND CHEMISTRY.

TO THE COMMITTEE ON PUBLICATION OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Albany, Nov. 3, 1845.*

GENTLEMEN,—We have lately attached to a cupola furnace for melting iron an apparatus for heating the blast, the operation of which has produced great economy in the consumption of coal. Designing that the public should not remain uninformed of so great an improvement, and believing that it excels in its economical operation all other cupolas, I take the liberty of enclosing to you, for publication in the "Journal of the Franklin Institute," a description of the same.

Yours, respectfully,

FRANKLIN TOWNSEND.

*Improved Cupola for Melting Iron, constructed by* MESSRS. FRANKLIN TOWNSEND, & Co., Albany, N. Y.

This cupola is of the ordinary construction, only being of enlarged dimensions, and made of cast iron. Its diameter at the *tuyères*, when lined with fire brick, is three feet; and its height, from the hearth to

the charging door, eleven feet. When charged full, it will contain three tons of pig iron, and is capable of melting upwards of twelve tons at one blast. The air is admitted into the cupola by six tuyères, which are placed about fifteen inches above the hearth, and equidistant on the circumference of the cylinder. To avoid the number of pipes which would be necessary if the air were conducted into the cupola by the usual method, an air chamber is made to surround the cylinder and enclose all the tuyères, and into this the main blast pipe is introduced. An opening is made through the outside of this air chamber, and directly opposite to each tuyère, which, being protected by a plate of glass, allows the *melter* to observe the working of the furnace. This plate of glass is so attached that it can be easily removed, and thus give free entrance to clear the tuyères whenever it may be necessary.

The air is heated by being forced through a number of small pipes, placed in such a manner in the interior of the stalk immediately above and directly over the cylinder of the cupola, that their outside surfaces are exposed to the full action of the waste heat of the furnace. For reason of the difficulty caused by the expansion of the metal when heated, these pipes are required to be of peculiar construction. By this arrangement, the air becomes heated during its passage from the blast reservoir to the tuyères, upwards of 400° Fahrenheit's thermometer.

This cupola has been in operation during the past three months, melting ten tons of iron daily. The iron is *charged* in the shape of *pig* and *scrap* (*sprues, gates, &c.*) in about equal proportions, and is cast into stove-plates, which requires that it should be very hot and liquid. The average consumption of coal (Lehigh) in melting this quantity of iron, is 225 lbs. to the ton of iron, and the rate of melting is from two to three tons per hour. An ordinary cupola, operated with cold blast, consumes upwards of 500 lbs. of coal to the ton of iron, and its rate of melting is from one to two tons per hour.

Not having the results of the operation of any hot blast cupola in this country, the comparison of the *working* of this improved cupola with them cannot be given; but its evident superiority to those of England is shown by the following extracts from a report\* made by M. Dufresnoy, chief engineer of mines.

"The cupola furnaces at the 'Tyne Iron Works' are operated with heated air. The consumption of coke is 280 *livres* (309 lbs.) to the ton of iron; rate of melting, one ton per hour.

"At Wednesbury, the cupolas are operated with hot blast, and consume 260 *livres* (287 lbs.) of coke to the ton of iron. Before the adoption of the hot blast, the consumption of coke was 400 *livres* (441 lbs.) to the ton of iron. The same quantity of iron is melted in one-half of the time that was required before the adoption of this process."

\*Extrait d'un rapport de M. Dufresnoy, ingénieur en chef des mines, sur l'emploi de l'air chaud dans les usines à fer de l'Ecosse et de l'Angleterre.—Bulletin de la Société d'Encouragement pour l'Industrie Nationale.—1834, p. 299. See also Journal Franklin Institute, vol. xv, 2nd series, for the whole of M. Dufresnoy's report.

*The Globes Celestial and Terrestrial. By A. DE MORGAN.*

This treatise is written to accompany Malby & Son's new globes and planispheres. The Messrs. Malby are spirited publishers of globes, as their prospectuses show; and reasonable ones too, in the delightful modern English sense of the word. Among the novelties they have put forward, is a globe which they call *perennial*, meaning that it can give the procession of the equinoxes, and thus enable any one to verify the astronomy of Hesiod or Eudoxes, without calculation. One of the last astronomical labors of Mr. Baily was the drawing a set of boundaries for Malby's celestial globes, so as to remove a few of the glaring anomalies which are usually presented. The new boundaries are in a broad line; the old ones, where the two differ, in a thin line. As to the treatise, the points in which it differs from others are briefly these:—Only the appearances of astronomy are explained, on the ground that the globe is connected with them alone: two persons, one of whom follows Ptolemy, and the other Copernicus, meet on common ground when they use a globe. Mr. De Morgan is of opinion that the general ignorance of the actual phenomena of the heavens makes it desirable that books on globes should confine themselves to appearances, and leave explanations of the appearances, and the grounds of them, to books on astronomy. Next, the tables of Ferguson for finding the new and full moon are given in an appendix, so that any person who is an adept (we had almost written add-ept,) at common addition can find his new or full moon for any month of any year from B. C. 1000 to A. D. 2000 within about a quarter of an hour. This introduces the beginner to an idea of astronomical tables: for the manner in which the moon's place is found from day to day in the Nautical Almanac is only by a larger quantity of the same sort of work.

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*British Woolen Manufactures and Wool.*

Returns upon this subject were issued on Saturday, by order of the House of Commons (on motions of Mr. Masterman and Mr. Aldam.) It thence appears that the declared value of the British woolen manufactures exported from the United Kingdom in 1844 was £8,204,836, of which £2,444,789-worth was exported to the United States of America. During the same year 65,079,524 lbs of sheep and lambs' wool, foreign and colonial, were imported into the United Kingdom, of which 1,924,826 lbs. were re-exported from the United Kingdom, chiefly to Belgium. Of British sheep and lambs' wool, 8,947,619 lbs. were exported to foreign countries; and 8,271,906 lbs. of British woolen and worsted yarn, including yarn of wool or worsted mixed with other materials. There were also imported into the United Kingdom 635,357 lbs. (of which 47,848 lbs. were re-exported) of alpaca and llama wool; and 1,290,771 lbs. of mohair, or goats' wool, of which 97,529 lbs. were re-exported.

London Farmer's Mag.

*On the Registry of the Hourly Variations of the Thermometer by means of Photographic Papers.* By MUNGO PONTON, Esq. F. R. S. E., F. R. S. S. A. Read before the Royal Scottish Society of Arts, 10th March, 1845.

An unexceptionable mode of registering the hourly variations of the common mercurial thermometer, has long been a desideratum in science. Hitherto we have been able to register only the maximum and minimum of temperature for each day and night, and even that in rather an imperfect manner; but to record the hourly movements of the mercury in the thermometer has not, so far as I am aware, been as yet successfully attempted. Various purely mechanical methods have been tried from time to time, but without satisfactory results. Nature, however, is full of appliances; and it only requires perseverance on our part to avail ourselves of the implements so profusely scattered around us.

The newly discovered phenomena of photography appeared to me likely to afford facilities for attaining the object in view; and the results I have arrived at lead me to hope, that we may successfully employ light to record, with its subtile pencil, the changes in the heat of the atmosphere.

The first difficulty to be overcome was to obtain a clear and well defined shadow of the filled portion of the bore of the thermometer, capable of being distinguished from the shadow produced by the empty portion. This is a matter of some nicety. After several trials, the following appeared to be the best mode of securing this result: Select a thermometer with a flat bore, and grind the stem down on one side nearly to the bore, so as to produce a flat, or rather slightly concave polished surface, and let the opposite side be ground only a little flat. If the latter flattened side be now exposed to the light of a lamp or gas flame, condensed by means of a cylindrical glass vessel filled with water, placed at a considerable angle, it will be found, that by a little nice adjustment, a certain position will be obtained, in which the shadow of the bore may be thrown on a piece of paper placed against the other ground surface of the stem, in such a manner that the shadow of the empty part of the bore is reduced almost to nothing, while that of the filled portion is considerably expanded and well defined. A little practice suffices to hit the best adjustment.

The next point was to obtain a photographic paper sufficiently sensitive to be affected by artificial light at a convenient distance, and in a sufficiently short time, but which could at the same time be kept long enough without injury. After various unsuccessful attempts, I have ascertained that paper prepared in the manner to be described, answers the purpose perfectly. The process is a modification of that discovered by Hunt, and to which he has given the name of *Energiatype*.

The paper is first to be coated with either the iodide or the chloride of silver; I prefer the latter. The usual mode of washing, first with the nitrate of silver, and then with either the iodide of potassium, or

the chloride of sodium, may be adopted for this purpose. It is desirable to have a good coating of either the iodide or chloride of silver on the paper. The soluble salt having been well washed out, by immersing the paper in clean cold water, it is next to have applied to it a saturated solution of succinic acid. In this state the paper may be preserved for any length of time, if kept dry, and carefully excluded from light.

Before use, a wash of the aceto-nitrate of silver, as directed to be prepared by Talbot, is to be applied. This gives the paper the necessary degree of sensitiveness, and in this state it may be kept without injury to its properties for two or three days, but not more.

If the aceto-nitrate be applied without the previous wash of succinic acid, the paper will be equally sensitive; but it will blacken spontaneously in the dark, and is therefore useless for the purpose. The succinic acid thus appears to exert a conservative influence in preventing spontaneous decomposition.

The photographic image formed on this paper is latent, and requires to be brought out by the application of a saturated solution of the sulphate of iron, mixed with three or four times its bulk of mucilage of gum-arabic. This mixture should be freshly prepared, for it soon becomes a jelly, which is unfit for use. The application of the sulphate of iron to the paper may be made at the distance of upwards of 24 hours from the time of the first impression of the latent image, which will, notwithstanding that lapse of time, come out distinctly; and thus a whole day's record may be brought out at once. The aid of a little heat is sometimes necessary for the development of the image.

The mechanical arrangements are these:—A black japanned cylinder of tin, about 4 inches diameter, and  $4\frac{1}{2}$  inches deep, has a piece of the sensitive paper wrapped round it. This cylinder is intended to be moved round by a time-piece, and to traverse behind the stem of the thermometer. It will be stationary for a half or a quarter of an hour as desired, at each division of the cylinder, and then be moved a division by a jerk. There will thus be time for the image to be completely formed by the action of the light. Around the cylinder carrying the sensitive paper is another blackened cylinder,  $4\frac{1}{4}$  inches diameter and 4 inches deep, with a slit in it just sufficient to admit the stem of the thermometer. This is intended to screen from the light all that portion of the paper which is not in action. A cover goes over the whole, the more effectually to exclude all light except that which passes through the stem of the thermometer. The stem itself is also furnished with wings of black paper, to prevent the light from spreading on either side.

The thermometer should have its stem twice the length of what is required for the natural range of temperature, so that the bulb may be placed at a considerable distance from the portion acted on by the light, in case of any increase of temperature from that cause; and the bulb and lower portion of the stem should be completely screened from the light. This is accomplished by placing the thermometer in a wooden box, the bulb and the lower half of the stem being in the

box, which is open behind to admit the air, while the upper portion of the stem, intended for use, is left standing above the box. The time-piece may be placed in this box if convenient.

The cylinders already described, are placed behind the exposed portion of the stem, so that the image of the bore may be received on the sensitive paper surrounding the inner cylinder, care being taken that the paper be applied as closely as possible to the stem.

The whole apparatus is now to be placed near a lamp, or a good sized gas flame, the light from which is to be concentrated on the stem by means of a cylindrical glass bottle filled with water as already described. If the registration is to be half hourly, the distance of the light may be about 2 feet; if every quarter of an hour, the distance should be about 1 foot.

By this arrangement, the image of the mercury in the bore, as it stood during each half or quarter of an hour, is impressed on the paper in a latent state, and the whole series may be brought out at once by the sulphate of iron, at the end of the 24 hours.

A scale is to be adapted to the cylinder to determine the degrees, and corresponding marks should be made on the paper, so that the scale may be applied to it after removal from the cylinder. A slip of paper about an inch and a half broad, placed on that portion of the cylinder where the mercury may be expected to range, will, in general, be found sufficient.

The same method of registration, although peculiarly applicable to the thermometer, may be also employed for the registration of the barometer and other instruments. It has this peculiar advantage, that it does not interfere in the smallest degree with the natural action of the instrument, but merely takes a picture of the state of the instrument during a given time. The chief expense would be that of the artificial light, but this might be partly economised, by a contrivance for that purpose. The same artificial light might also be used for registering several instruments.

The photographic paper which I have found best adapted for the above purpose, is equally fitted for taking landscapes in the camera obscura, because it keeps well for being taken to the field, and may also be allowed to remain for so considerable a time before the image is brought out.

*Additional Communication.* Read before the Society, May 12, 1845.

Since my former communication to the Society on this subject, Mr. Bryson has had the kindness to adapt to the photographic thermometer a clock movement, so as to complete the arrangements necessary for a half-hourly registration of the temperature. The connexion is formed by means of a spindle, terminating in a small pinion, and attached to the striking train of the clock. The pinion works into a horizontal toothed wheel, carrying the cylinder, on which is placed the sensitive paper, and which is thus, by the action of the clock, moved one division every half hour.

Farther experiment having proved, that, by a more perfect concentration of the light, a sufficient effect could be produced on the paper

by an exposure of four or five minutes, it appeared advantageous to limit the exposure to this extent, by providing for the raising and lowering of the gas flame, so that it might be raised to its full pitch for about five minutes every half hour, and continue burning with a very small flame during the rest of the time.

In order to obtain a better concentration of the light, I employ a lenticular piece of glass,  $4\frac{1}{2}$  inches in length, 3 in width, and about  $\frac{1}{2}$  inch thick in the middle. This produces a long narrow light along the stem of the thermometer. I find it advantageous, in using a fish-tail burner, to turn the edge, instead of the flat side of the flame, towards the lens.

For the purpose of raising and lowering the gas, the clock is furnished with two hands, forming a diameter of the circle. Over or under the centre on which these hands turn, is placed a perpendicular lever, terminating at bottom in a small roller. Proceeding from one end of the lever is a thread passing over a pulley at a little distance, and having a small weight suspended to it, by which the lever is pulled a little aside from the perpendicular position.

In the gas tube a knee is formed, and immediately over the place where the gas passes from the perpendicular into the horizontal tube, there is a small rectangular chamber; and the termination of the perpendicular pipe is a flat, rectangular piece of brass at the bottom of the chamber, having a hole in its centre for the admission of the gas. On this flat surface rests a small rectangular piece of iron, reaching to about  $\frac{1}{16}$ th or  $\frac{1}{20}$ th of an inch from the top of the chamber which is closed. Above the flat top of the chamber is suspended, on an axis, a small horse-shoe magnet, with a lever several inches long projected from its upper curvature. To the end of this lever is attached a thread, which proceeds to the upper limb of the lever above the clock. By this attachment the magnet is drawn aside from the chamber in the gas tube, and, consequently, the piece of iron in that chamber being unaffected by the magnet, rests over the orifice for the admission of the gas, which it closes to such an extent as to admit only a minute portion, sufficient to keep up a very small flame.

When the hands of the clock approach the perpendicular position, the upper hand presses against the roller at the bottom of the lever; and, as the hand moves round, it carries the lever with it, and thus raises the small weight above mentioned, at the same time slackening the thread attached to the magnet, which being thus at freedom to move, is attracted towards the iron in the chamber. So soon as the poles of the magnet reach the top of the chamber, the piece of iron jumps up towards them, and thus lets on the full flow of the gas, raising the flame to its highest pitch at once. This state of matters remains while the hand of the clock moves onwards for about five minutes, carrying the lever with it, and so continuing to raise the small weight. At the expiration of the five minutes the hand of the clock passes the lever, which instantly returns to its original position, and, in consequence of the accumulation of power attending the fall of the weight from the height to which it has been raised, the lever returns with such force as to jerk the magnet away from the chamber

in the gas pipe, and thus allow the piece of iron in that chamber to drop into its original position, and thereby reduce the gas flame at once to its lowest point.

By these means the raising and lowering of the gas is accomplished with less strain upon the clock than it would be were a stop-cock employed.

In order to prevent the action of extraneous light during the day, it has been found advisable to place between the lens and the thermometer, a small screen, which is opened and shut by the action of the same lever that raises and lowers the gas. The thermometer is thus exposed only while the gas flame is at its height.

For the successful production of the images of the mercurial column in the thermometer tube, every thing depends on the light being made to fall upon it at the proper angle, so as to obliterate the shadow from the empty part of the bore, and increase the shadow produced by the full portion. Unless this position be hit the images will not be distinct.

As it appeared desirable to have it in our power so to arrange matters that the clock might be inside of the house, while the thermometer and registering cylinder stand outside, I have contrived a method by which this may be accomplished. It is on the same principle as that by which the gas is raised and lowered, and may be managed by the same lever, so that the shifting of the cylinder takes place at the same instant that the gas is lowered, just after the registration has been completed. The only connexion between the clock and the cylinder is a thread, which may pass through the window. I have had this plan in action, but the apparatus requires some little alteration.

By this arrangement it is easy to cause the same clock to register both a thermometer and a barometer, or even a barometer and two thermometers, one placed in the sun, the other in the shade; while the registration of the barometer may be either by the photographic method, or by the mode previously invented by Mr. Bryson. Ed. Philos. Jour.

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*On "Gutta Percha," a peculiar variety of Caoutchouc.* By DOUGLAS MACLAGAN, M. D., F. R. S. E., &c. Read before the Royal Scottish Society of Arts, 23d June, 1845.

*Gutta Percha* is the Maylayan name for a substance which is the concrete juice of a large forest tree, native of the shores of the Straits of Malacca, Borneo, and the adjacent countries. The tree yielding it is unknown botanically, all the information we possess regarding it being, that it is a large forest tree, and yields this product abundantly. We are indebted for our knowledge of it to Dr. W. Montgomerie, H. E. I. C. S., whose spirited exertions to improve the cultivation of various articles of colonial produce at Singapore have obtained for him several distinguished marks of approbation from the Royal Society of Arts of London. For his communication regarding gutta percha, Dr. Montgomerie received a silver medal from the Society

This substance, in its crude state, differs, in many particulars, from common caoutchouc. It is of a pale-yellowish, or rather dirty-white, color. It is nearly as hard as wood, though it readily receives the impression of the nail. It is very tenacious, and not at all elastic.

It seemed to me to be worth while to determine, whether or not this substance really was a variety of caoutchouc, and for this purpose I subjected it to the ordinary process of ultimate analysis, and obtained as its per centage composition, carbon, 86.36; hydrogen, 12.15; the remainder, 1.49, was most probably oxygen absorbed from the air during the process employed for purifying it, as the substance, whilst heating on the vapor-bath, acquired a brown color. The only analysis of common caoutchouc with which I am acquainted is that of Faraday, who obtained, carbon, 87.2; hydrogen, 12.8. The results are sufficiently near to warrant the conclusion, that the two matters in question are generically the same.

I found, also, that the gutta percha yields the same product of destructive distillation as the common caoutchouc. Without entering into details, I may briefly state, that both equally yield a clear, yellow, limpid oil, having no fixed boiling point, and, therefore, being a mixture of different oleaginous principles. In both instances, the distillation proceeds most freely at temperatures between 360° and 390° Fahr., and seems almost stationary at 385°. Comparative analysis of similar portions of the two oils were made, and, as is already known of common caoutchouc, the products exhibit a constitution represented by the formula  $C_{10}H_8$ . The gutta percha thus appears really to be a modification of caoutchouc.

In its general properties it likewise shews a similarity to common caoutchouc. It is soluble in coal naphtha, in caoutchouc oil, and in ether. It is insoluble in alcohol and in water, and floats upon the latter.

Its most remarkable and distinctive peculiarity is the effect of heat upon it. When placed in water at 110°, no effect is produced upon it, except that it receives the impression of the nail more readily; but when the temperature is raised to 145° degrees or upwards, it gradually becomes so soft and pliant as to be capable of being moulded into any form, or of being rolled out into long pieces or flat plates. When in the soft state, it possesses all the elasticity of common India-rubber, but it does not retain these properties long. It soon begins again to grow hard, and in a short time, varying according to the temperature and the size of the piece operated on, regains its original hardness and rigidity. A ball one inch in diameter was completely softened by boiling water in ten minutes, and regained its hardness completely in less than half an hour. It appears to be capable of undergoing this alternate softening and hardening any number of times without change of property.

It is also to a certain extent ductile. When soft it is easily torn across, but when hard it is very tenacious. A piece not an eighth of an inch in thickness, when cold, easily raised a weight of forty-two pounds, and only broke when half a hundred weight was attached to it.

From these properties, it seems capable of many applications in the arts. Its solution appears to be as well adapted as that of common caoutchouc for making water-proof cloth, and, whilst softened, it can be made into solid articles, such as knife-handles, door-handles, &c. Malays employ it for the former of these, and prefer it to wood. A surgeon, furnished with a small piece, could easily, with the aid of a little hot water, supply himself with bougies or pessaries of any size or form.

[Dr. M. exhibited a knife-handle, a walking-cane head, a riding-whip, and other articles, made of gutta percha.] Ibid.

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*Instructions for Observing the great Symmetrical Barometric Wave.* By W. R. BIRT.

The notice of my report on Atmospheric waves, published in the *Athenæum*, [No. 923,] contains an allusion to the recurrence of a wave of a most remarkable and interesting character. From the 11th to the 18th of November, in the year 1842, the barometer was observed to rise at London from below 29 inches to about 30½ inches, with occasional depressions, so that on projecting the observations in a curve, it was found to be indented. After passing its maximum on the 18th, the barometer gradually fell until the 25th, when it stood slightly above the same altitude as observed on the 11th. This fall was interrupted by occasional elevations, which were of such a character as to give the whole curve of rise and fall an extremely symmetrical appearance, the descending branch being almost a counterpart of the ascending. The same symmetry was observed at Dublin and Munich. On projecting the observations at these stations, allowance having been made for difference of longitude, the motion of the wave, from Dublin to Munich, became very apparent, and no doubt could be entertained of its transit in that direction; (the reader is referred to an engraving of the wave as it passed the three stations, Dublin, London and Munich, accompanying Sir John Herschel's report on 'Meteorological Reductions,' in the report of the Thirteenth Meeting of the British Association for the Advancement of Science.) An examination of observations made at stations situated to the north-east and south-west of the line joining Dublin and Munich, shows that the symmetrical character of the wave (or at least of the barometric projections) was confined to *that line*, for, on either side, the symmetry is departed from, the character of the rise on one side being transferred to the fall on the other—the line from Dublin to Munich being, with regard to the barometric movements of the fourteen days, a kind of axis.

The barometric oscillations during the fourteen days, from November 7th to 21st, in the year 1843, again afforded a symmetrical wave or curve. The indentations or inflexions of the rise and fall in 1843 were *not* similar to those of 1842, but the same period, and the rise above thirty inches, clearly showed that on abstracting the *secondary* oscillations, the *same* or a very *similar* cause operated on the baro-

meter during these days in 1843, that occasioned the general rise and fall, from the 11th to the 25th of November, 1842. — At the request of the British Association, I undertook an examination of the symmetrical wave of November, 1842, which I commenced in September, 1843. One of the results of this examination has been to determine that the inflexions on the slopes of the large symmetrical curve are due to smaller waves, and that *systems* of these smaller waves are moving in various directions. The latest results of my researches relative to these secondary waves, are given in the notice of my report already alluded to [*ante*, No. 923.] These researches tend very much to establish the idea of a large *normal* wave, and render very probable that the wave observed in 1843 was the *same* as that observed in 1842, although the inflexions arising from waves of a secondary character were different.

The autumn of 1844 again brought us this interesting visitor. During the period, from October 21st to November 2nd, a rise and fall of the barometer occurred, in many respects similar to the two preceding: the identity in this case was not so distinctly marked, but there was still sufficient symmetry in the ascending and descending branches of the curve to render it highly probable that the oscillation was due to the same cause that produced those in 1842 and 1843.

This great similarity in the barometric movements occurring about the same period in three consecutive years, induces a hope that this wave may again return; and meteorologists are invited to direct their especial attention to the oscillations of the barometer during the months of October and November next; should it return, we shall, by multiplying observations upon it, be in a much better position to examine it in every possible aspect, and by separating from the observations every circumstance that can at all influence the barometer, we shall be able to contemplate it entirely free from every cause that can at all influence it, and by which its form, direction, velocity, &c., may be modified.

In order to carry this out effectually, two or three considerations are essential.

1st. It appears that the line joining Dublin and Munich is an axis or line of greatest symmetry; it is, therefore, desirable that numerous observations should be made on this line—Birmingham and *Brussels* are two important stations on it.

2nd. As nearly as possible stations should be chosen on each side this line, so that they may be arranged with a certain regard to symmetry. A much better idea of the wave could be obtained from observations made at stations equally disposed with respect to it than otherwise.

3rd. Those instruments should be observed contemporaneously with the barometer that are capable of giving us information by which we can obtain the true pressure of the gaseous atmosphere.

With this view, I have drawn up the following instructions, which I shall be most happy to forward to gentlemen desirous of taking part in these interesting observations, (upon being applied to for that pur-

pose,) accompanied with printed forms for recording the observations.

The instructions consist—

1st. Of the times of observation.

2nd. Of the instruments to be observed.

3rd. Of the data necessary for reducing the observations, and rendering them suitable to be employed in this inquiry.

*Times of Observation.*—The following hours are the most suitable for the object now in view: 3 A. M., 9 A. M., 3 P. M. and 9 P. M.; these hours divide the day into four equal parts; they have been recommended by the Royal Society as *meteorological* hours, and are the hours at which observations are made daily, by direction and under the superintendence of the Honorable the Corporation of the Trinity House, which have been most advantageously used in the examination of atmospheric waves. In cases, however, in which the observation at 3 A. M. may be inconvenient or impracticable, it will be important to substitute for it *two* observations, one at midnight and the other at 6 in the morning, so that the hours of observation will in such cases be 6 A. M., 9 A. M., 3 P. M., 9 P. M. and midnight. To individuals who cannot command these hours, it is recommended that observations should be made *as near them as possible*; these will still be valuable, although not to so great an extent as those made at the regular hours. In these cases, however, it will be absolutely necessary to substitute *two* readings for every one of the regular hours omitted—one previous to, the other succeeding, the hour so omitted; and these should, if possible, include an equal interval both before and after such hour. In all cases the *exact* hour and minute of mean time at the place of observation should be inserted in its appropriate column in the form for recording the observations.

*Instruments to be observed.*—At the regular hours of observation, or any others that the observer may fix upon, in accordance with the foregoing instructions, it will be necessary to observe,—1st, The barometer, with its attached thermometer, and enter in the form the *actual* height observed, with the temperature of the mercury. 2nd, The external and dry thermometer. 3rd, The wet bulb thermometer. (These observations are particularly essential, in order to separate the pressure of the vapor from the aggregate pressure, as measured by the mercurial column.) 4th, The direction and force of the wind. (These are important to determine the connexion between the undulatory and molecular motion of the wave.) 5th, The character of the weather at the times of observation; which may be recorded by Capt. Beaufort's symbols. It is proposed to commence the observations on the 1st of October next, and continue them *daily*, until the end of November, unless it should be found that at that time the wave is not completed, in which case it will be requisite to continue them a few days longer.

*Data for Reduction.*—It will be necessary, on returning the form when filled, to accompany it with the following data for reduction. A blank is left for this purpose on the back of the form. The geographical co-ordinates of the place of observation, viz. latitude and longitude. The altitude of the cistern of the barometer above the

level of the sea, *exactly*, if not, as near as it can be obtained. The internal diameter of the tube of the barometer. The capacity, neutral point, and temperature. (These are usually engraved on the instrument.) If the co-efficients of the diurnal and annual oscillations have been determined for the place of observation, include them. Those sets of observations which may be reduced by the observers should be accompanied with the original observations, and a reference to the tables used in their reduction, also the data above mentioned. All observations that may be made in accordance with these instructions and forwarded to me, will be carefully examined and reported on at the next meeting of the British Association.

N. B.—Observations will be made at several light-houses, by direction of the Honorable the Corporation of the Trinity House, and Capt. Beaufort has kindly undertaken to obtain observations from several of our surveying vessels.

London Athenæum.

*Extracts from the Proceedings of the Paris Academy of Science.*

APPARATUS FOR INDICATING DANGER FROM FIRE DAMP, OR ESCAPE OF GAS, by *M. Chuart*.—M. Chuart's invention consists of a ball or globe, contained in a chemical solution highly sensible to any deterioration of the atmosphere, and acting upon a lever, which sets an index in motion, and thus shows the vitiated state of the atmosphere, whether in a mine, or elsewhere, long before the common air can be so saturated with gas, as to explode on the application of a light. M. Chuart has added to his invention an alarm bell, which is struck by the lever when the ball is thrown off its equilibrium by the vitiated state of the atmosphere. Since M. Chuart first exhibited his apparatus he has made a great improvement. His ball was originally of glass, which was not only too heavy, but also liable to breakage. He now makes it of copper, so very thin that its weight is almost nominal, and yet it is perfect in every part. We understand that he arrived at this perfection by means of the galvanic process, which gives a thinner substance than any mechanical means could effect consistently with the compactness that is required for the certain operation of the apparatus.

ON THE RADIATION OF HEAT, by *M. Melloni*.—It is known from the experiments of Rumford and Leslie, that the surfaces of different bodies possess in very different degrees the faculty of giving out by radiation the heat of the substances which they envelope. It is also known that layers, more or less thick of the same varnish, or other covering of this kind, considerably modify the radiating power of the surfaces over which they are laid. This fact showed that the rays of heat given out by a substance proceeded not merely from the surface, but also from points under it, and at a certain depth. What remained to do was to measure numerically the thickness of the superficial layer which assists the radiation; this is what M. Melloni has undertaken. He covered the faces of Leslie's cube with equal layers of a proper varnish, augmenting successively the number of layers, and

measuring each time with his thermometrical apparatus the radiating powers of the surfaces. He found that the power went on gradually increasing up to the seventeenth layer of this varnish, when it became stationary. At this time, the total thickness of the varnish, as ascertained with all possible minuteness, was about four hundredth parts of a millimètre (as the millimètre itself is only the thousandth part of about three feet, M. Melloni must have had great difficulty in coming to this minute calculation.) In comparing the preceding results with those which attend the use of leaf gold, M. Melloni found that a much thinner coating of gold (viz. two thousandth parts of a millimètre) would produce the same amount of radiation. M. Melloni shows that this difference is not to be imputed to the greater or lesser transparency of the coating, for lamp black, which is very opaque, possesses, like varnish, the property of giving out the rays of heat from the layers on which it is placed.

ON POISONING BY METALS.—Messrs. Danger and Flandrin presented a final paper upon poisoning by metals. The metal particularly noticed in this paper is mercury. Hitherto it has been difficult to detect the presence of mercury in organic matter when administered in some of its combinations. Messrs. Danger and Flandrin have succeeded in the means of discovering even the hundred-thousandth part of a grain. Their analytical process, after carbonization with sulphuric acid greatly modified, is with the galvanic pile of Smithson, with a certain modification, by which the gold conductors plunge in the suspected liquor and separate the mercury.

ATMOSPHERIC RAILWAY, proposed by *M. Arnollet*.—A report was read by *M. Lainé* on a system of atmospheric railroad proposed by *M. Arnollet*. In the system of *Mr. Clegg* it is necessary, in order to expel the air from the directing tube, to employ a powerful steam engine, the action of which is interrupted during the time that elapses between the arrival of one train and the departure of another. To prevent the loss occasioned by this intermittence, *M. Arnollet* proposes to employ a smaller engine for the constant exhaustion of one or more grand reservoirs, to be put in communication with the tube during the motion of the trains. No experiment on a sufficiently large scale having been made to test this modification, the Committee appointed to report has given no positive opinion. Judging, however, from the elements of *M. Arnollet's* theory, the committee thinks it possesses certain advantages which render it worth an experimental trial.

CHEMICAL EQUIVALENTS.—*M. Pérouze* presented his new table of the equivalents of most of the simple bodies in chemistry, as compared with the table of *Berzelius*. It results from the conclusions of *M. Pérouze*, that azote, phosphorus, and arsenic, are the only bodies with carbon, the equivalents of which are exactly divisible by 12.5, the equivalent of hydrogen, and that, consequently, we cannot give to the law of *Dr. Prout*, by which the equivalents of all bodies are exact multiples of that of hydrogen, the general character which *M. Dumas* supposes.

WHIRLWIND NEAR ROUEN, AUGUST 19TH, 1845.—M. Arago gave, from letters which he had received, an accurate account of the whirlwind, which, on the 19th inst., caused so much disaster near Rouen. M. Precisier states that the blast, or whirlwind, in question had its origin at Houlme, a village two leagues from Rouen. Two violent winds proceeding in contrary directions having met, a cone was formed, which descended from the clouds, with its summit towards the earth, and had a revolving motion of terrible rapidity. From its centre issued flashes of lightning, and it emitted a strong smell of sulphur. Some persons, who saw it advance with enormous speed, have assured M. Precisier that the black and red clouds moved vertically, driven backwards and forwards with prodigious force; they also heard a rolling noise, similar to that which precedes hail. The barometer fell suddenly from 29·786 in. to 29·156 in., the temperature of the air became much elevated, and the whirlwind was preceded by a current of air so warm that some persons before a large fire felt it strongly. The meteor rushed eastward, overthrowing everything it met with in its course; it passed through a forest without losing any of its power, —snapping off or twisting the trees, and casting them right and left— and then struck a cotton factory four stories in height, and in a second demolished it, crushing the persons who were within its walls. The dwelling-houses which were in the immediate vicinity of this factory were but slightly injured; for the whirlwind did not take a direct course, but went in zig-zag, and appeared to be attracted by the great masses of iron in the machinery of the factories. At the second factory that it attacked, the third floor was swept away in an instant, and some of the fragments were carried to a distance of several leagues. The third factory, in which there were nearly 200 persons at work, was demolished with the same rapidity as the other two. The meteor then continued its course towards Malaunay, devastating the country as it proceeded; but at Clèves its effect ceased. A violent wind, caused by this frightful perturbation at one point, blew from it towards all the environs, and was felt at a great distance. At La Chapelle, near Dieppe, a distance of nine leagues, a shepherd saw fall a plank of more than a metre in length; slates, portions of windows, cotton, and many other objects fell near the same spot. All the facts which were witnessed, says M. Precisier, prove the presence of electricity in this visitation. The bricks and stones of the buildings which were destroyed were burning hot, and many articles were carbonized on the outside. Some spindles were found to be magnetized; but M. Arago observed that this might have been the case before the disaster. The bodies of the victims presented no marks of external injury; they resembled those of persons struck by lightning. As to the light which was seen to issue from the centre of the meteor, no doubt of its being electric can be entertained, and it was visible at a great distance. In the neighborhood of the disaster, a family, who were about to sit down to dinner, suddenly saw the table uncovered; the plates and dishes danced in the air, and a frying-pan was driven upwards, and forced into the ceiling, surrounded by a light which rapidly disappeared.

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## ERRATA.

Vol. IX, page 420—line 14th from bottom—for "30m." read "51m."

" 12th " " " "James A. Dean" read "James Dean."











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